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CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

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POPULARIZING ELECTRICITY.

The topic attracting the most interest among those dealing in electrical apparatus and energy is the ways and means of increasing the use of this agent, thereby not only increasing the business of the power-houses, but of the manufacturing companies as well. Very many plans have been suggested, and many are being tried, with more or less success. One having a good deal of interest is reported from Brussels. It seems that Mr. R. Goldschmidt, of that city, has established a free laboratory and museum of electrical apparatus. Here are on exhibition all kinds of appliances, set up so as to demonstrate their action. In the laboratory facilities are available for carrying out all kinds of tests. The originator of this idea has even gone further, and provides means for scientific study in certain branches of physics and chemistry. This is an original idea which, if properly used, will undoubtedly help greatly in spreading the use of electrical methods; but it will probably be found almost as difficult to induce people not prompted by idle curiosity to avail themselves of the facilities here offered as it would be to get them to adopt electric lights or motors at once. No doubt there will be a number of men or companies who will be very glad of the opportunities thus offered, but since the apparatus can almost always be secured with a guarantee, to many this will be preferable to making tests under conditions not actually those to be fulfilled. For the laboratory to be successful it must itself be widely advertised. The same is true, to a greater or less extent, of any exhibition. For instance, an exhibit of electrical appliances undoubtedly helps in increasing the use of them, but to accomplish the most good the exhibit itself must be made popular. The necessity for advertising is not avoided though the immediate object of attention is changed.

MECHANICAL BRAKES FOR CITY RAILWAYS.

It is rather strange that a wider use is not made of mechanical brakes on city street railway systems. The development of suburban and interurban lines on which heavy cars are run at high speeds has made necessary the adoption of some form of braking other than the simple hand brake, but except, perhaps, on those city lines which extend into the suburbs, the hand brake seems to be the standard equipment, in spite of the fact that many of the city cars in size and weight compare with the high-speed interurban cars. Exception should be made to this statement with respect to certain cities where mechanical brakes are generally used, but the old method, which was adequate for horse-cars, still persists in some of our most important towns.

The reason for this is not a lack of a satisfactory mechanical brake, for there are both electric and air-brake systems suitable

for city cars. These appliances are not in an experimental state. They have been thoroughly developed and tried. Nor would there seem to be any difficulty in training the city motorman in the use of these appliances, since he is certainly not in any way less capable than the motorman on the interurban car. It may be urged against them by the railway companies that they are expensive, both to install and to maintain. This is true, if comparison be made simply with the hand brake; but it may be said with equal justice that the motor equipment costs more than horses. Improved methods of traction making it possible to run heavier cars and to make higher speeds certainly call for improved safeguards. The additional expense is compensated, in part at least, by an improved service and a reduction in the number of accidents.

A valuable feature of the mechanical brake is that it reduces the strain, both physical and mental, upon the motorman. It requires the exercise of considerable strength to stop a heavy car with a hand brake, and certainly the man who is tired physically can not be as alert as one who is less fatigued. He will then run his car with less thought to the comfort of the passengers, and is much more likely to have accidents. As an instance where this feature is well realized we may point to the systems in St. Louis, where the cars are equipped with air brakes, and the motorman is provided with a seat which he uses when in the outlying parts of the system, discarding it only when his car reaches the busy down-town section.

This question of the use of mechanical brakes has been under investigation by a committee of the Congress of the International Union of Tramways and Short Railways, which met recently in Vienna. The committee consisted of two experienced tramway men who have had this subject under study for several years. Their report was in favor of a mechanical brake, but the two members could not altogether agree upon the type of brake most suitable. Mr. Scholtes, director of the Nuremburg-Fürth Tramways, looked at the matter from the statistical point of view. He believes that when, on account of the weight of the cars, or the use of trailers, or when, for any other reason, the hand brake can not be safely employed, a mechanical brake should be adopted, and, in general, this should be an electric brake. On the other hand, Mr. E. R. Bjorkegren, chief engineer of the Grosse Berliner Strassenbahn, while agreeing with Mr. Scholtes as far as the use of mechanical brakes is concerned, thinks that the air brake is the more satisfactory, mainly because it acts more quickly than the electric brake and therefore gives the motorman more confidence. Both members of the committee agree that the electric brake costs less to install and to maintain than the air brake. It may, however, involve certain other disadvantages. For example, when the current utilized is drawn from the motors acting as generators, the average load on the motors is increased. If, on the other hand, the current is drawn from the line, the brake may be put out of commission when the supply from the line is interrupted. The air brake also has its weak points. But the important thing is not whether the mechanical brake should be operated electrically or by means of compressed air, but that such brakes should be more widely used, and that, with the standard type of car found to-day on city streets, the whole dependence should not be placed upon a short lever worked by hand. The electrical equipment of the heavy city car may consist of two fifty-horsepower motors, put on mainly to enable the car to start rapidly. But although it may occasionally be much more important to stop suddenly, the old hand-operated mechanism is still largely depended upon.

There is another feature, too, in the use of the mechanical brake which is seldom found when the hand brake only is employed—that is, the provision of an emergency brake. Not infrequently this emergency brake is itself a hand brake placed there for use when the mechanical equipment fails. It is not expected to be brought into service for sudden emergencies, such as preventing a collision. In that case, if the mechanical brake fail, there is probably little time to do anything else, but it is a great safeguard in case the mechanical device breaks down on a grade. In a similar situation the motorman on the car equipped only with hand brakes must depend upon his motors if the hand brake fails. It may be contended that the latter type of brake is less liable to trouble than are the mechanical brakes, but they do fail sometimes, and when they do, not only is there no supplementary brake, but the motorman is apt to be physically in a poor condition for meeting emergencies.

The situation as regards the braking of city cars is similar to that existing a short time ago in connection with the signaling on interurban lines. Cars were operated at steam railroad speeds without any particular signal system, and this often done on highways, which aggravated the troubles, for it was dangerous not only to those using the railway, but to others simply passing along the highway. In both cases we have developed the motive power more rapidly than our safeguards; or, rather, we have been more ready to avail ourselves of the former than of the latter, for there are to-day both signaling systems and braking devices which are entirely satisfactory.

WIRELESS TELEGRAPH CONFERENCE.

A conference representing thirty-one governments assembled at Berlin on Wednesday of this week to endeavor to reach some understanding in the use of this means of communication. The conference was called together by the German government, which took the initiative in this matter because the Marconi Company has refused to exchange messages with stations equipped with the Slaby-Arco apparatus, the system used by that government. In 1903 a similar conference was held, in which, however, only eight governments took part, these being the United States, Germany, Great Britain, France, Italy, Spain, Russia and Austria-Hungary. A protocol was agreed upon and signed at the earlier conference by the delegates of six of the governments, those from Great Britain and Italy not signing, because of contracts between their government and the Marconi Company. But little good has come of this agreement, as the Marconi Company still adheres to its old policy and receives messages only from stations and vessels equipped with Marconi apparatus. It was for this reason that the Marconi apparatus was removed

from the Nantucket lightship in 1904, as the company refused to accede to the request of the government at Washington to receive messages from German vessels. The conference now in session will probably last for a number of weeks. No doubt many important matters will come up in addition to the one at present causing the most friction, but it is, of course, impossible to indicate in the least the probable trend of action.

At another conference, held the latter part of September at Ghent, the use of wireless telegraphy in time of war was taken up and a number of articles adopted which will be found on another page of this issue. In general, these articles concern only the belligerents, but one of them may cause great inconvenience to non-combatants. This is the one which gives belligerents the right to prevent the transmission of Hertzian waves by a neutral state over the high seas within the sphere of their military operations. The high seas—that is to say, waters lying beyond the three-mile limit—have always been considered free to all, but this article would deny non-combatants the right to make use of wireless telegraphy if the fleets of the states at war should choose or happen to come within range of the sending stations. At the present time, when no attempt is made to direct Hertzian waves, an unfriendly fleet might deny the right of a neutral state to send messages along its own coast or even inland, because the waves, which spread out in all directions, might be thought to interfere with the fleet's own apparatus. In other words, two quarreling countries might take it upon themselves to throw out of service a system of communication of world-wide importance, and it would be intolerable if this should be allowed to become the general practice. Wireless telegraphy is becoming of too much importance to put it under this limitation.

THE BINNACLE A CAUSE OF ERROR IN A COMPASS.

A recent accident to a yacht which ran on a reef near Portland harbor warrants a suggestion to owners of yachts. The facts are: before starting on a cruise the compass was adjusted, but the vessel was sailed by day and in clear weather, until, from a certain buoy in Massachusetts Bay, a course was laid to Portland harbor, and when the threatened fog fell the boat could be steered only by compass, and breakers were heard near Portland Head, where the vessel ran on a reef, from which it was removed without injury, and later reached Portland harbor.

It was apparent that the compass was in error, and on the return trip a course was laid out from Portland harbor to outside of Cape Ann, some fifty miles distant, and it became evident that steering on this course would bring the boat several miles to the westward and on the rocks of Cape Ann.

At the home port, the evidence of this error in the compass was submitted to the expert who had adjusted it a short time previously, and on reexamination the compass was found to be correct.

After this was completed and the brass binnacle cover holding the glass panels, which had been removed for the test, was replaced, it was noted that the compass moved. On further examination it was found that this "brass" cover was magnetic, and that this was due to its lower edge being a bead spun over a ring of large iron wire.

Is it not possible that other binnacle covers may be made in a like dangerous manner and be a source of peril in navigation? Some time ago the story was related that it was found the compass on a vessel lighted by electricity was in error when the circuit was charged. It was found that the wires were coiled in such a manner near to the binnacle as virtually to make a galvanometer, but the deviation of the needle was so great that no one was deceived, although at first the cause may not have been apparent.

For boats illuminated by electricity no further suggestion is necessary, as the person in charge of the electric lighting plant can readily make the tests; but for other boats not so equipped the test may be easily made when the vessel is stationary by removing the binnacle cover and noting if holding it in different positions around the compass affects the direction of the needle.

THE RADIUM CONTROVERSY.

On another page of this issue an exceedingly interesting summary of the recent controversy on radium, made by Mr. Frederick Soddy, is reprinted from *Nature*. Mr. Soddy is one of those who have taken a very energetic part in advancing our knowledge in the new field of radioactivity, but, in his summation of the situation, he takes a fair stand. He points out that while a number of men eminent in science did or were ready to take part in the controversy and uphold the new idea, the opposition was left practically to Lord Kelvin, among the physicists, and Professor H. E. Armstrong, among the chemists. The greater body of younger men seem to have been too thoroughly impressed with the evidence in favor of the new ideas to set them aside lightly.

The controversy, has, however, had one desirable result: it has established a better understanding, and will probably result in the designation of radium, for a time at least, as a compound, without the descriptive term, "chemical," the reason being that there is no question that helium is given off from what appears to be pure radium.

Mr. Soddy naturally lays a great deal of stress upon the large amount of experimental evidence in favor of the disintegration theory and the fact that no experiment as yet conducted fails to conform to this idea, and he urges those who are inclined to doubt to undertake some experimental work themselves. Nothing original need be attempted: all that is necessary is to repeat experiments which have been very completely described. This advice is reasonable, for it is not fair to those who have expended so much time and labor in acquiring knowledge for one who knows nothing about it at first hand to condemn entirely the work of the other, no matter how greatly the results differ from his own ideas. He should at least repeat the other's experiments before denying the results.

American Electrochemical Society.

The following provisional programme has been issued for the tenth general meeting of the American Electrochemical Society, which will be held in New York city next week. The members of the society have been invited to join the committee of the Perkin memorial celebration in a banquet to be given Sir William Perkin at 8 o'clock on Saturday evening, October 6.

On Monday, October 8, at 9 A. M., a meeting of the board of directors will be held at Columbia University. At 10 A. M. there will be a session for reading and discussion of papers and an experimental lecture. At 2.30 P. M. there will be a lecture by Charles Baskerville, Ph.D., on "Use of the Ultra-Violet Light in the Laboratory and in Practice," at the chemical laboratory of the College of the City of New York.

Tickets will be provided by the local committee for visiting numerous points of interest on Monday afternoon, including several large power-houses, the electrical testing laboratories, the Pennsylvania Railroad tunnel under the Hudson river, the Weston Instrument Company and the Edison laboratories at East Orange, N. J.

On Tuesday, October 9, at 9.30 A. M., there will be a session for reading and discussion of papers, and a lecture on pyrometers, with an exhibition of commercial instruments. On Tuesday afternoon the members of the society and guests will be conducted to the plant of the American Smelting and Refining Company, near Maurer Station, N. J.

The following papers are announced for presentation at this meeting:

"Formula for the Electromotive Force of a Helmholtz Concentration Cell," by Henry S. Carhart.

"An Aluminum and Magnesium Cell," by G. H. Cole and H. T. Barnes.

"The Decker Primary Battery," by F. B. Crocker.

"Visible Migration of Particles Between Electrodes," by Carl Hering.

"Some Factors Affecting the Distribution Law," by H. E. Patten.

"Melting Points of Some Cryolite-Alumina Mixtures," by Francis R. Pyne.

"Double-Decomposition of Zinc Sulphate and Sodium Chloride," by P. B. Sadtler and W. H. Walker.

"Some Small Laboratory Appliances for Electric Fusion and Other Work," by S. S. Sadtler.

"A Thermo-Electric Pyrometer for General Industrial Applications," by F. F. Schultz.

"Copper Cathodes in Nitric Acid," by J. W. Turrentine.

REMOVING OIL FROM EXHAUST STEAM.[1]

BY ALBERT A. CARY.

Separation of oil from condensed steam has been a problem of great moment, and many methods and devices have been used to effect its removal, all of which may be classified in the six divisions in the first of which baffle plates or screens are used, the exhaust steam being thrown against these surfaces and allowed to pass, while moisture and free oil cling to the plates and are separated. In the second method, the steam delivered by the engine is sent through filters, generally composed of coke or some other loose material, while in the third process the steam is exhausted from the engine through a series of pipes having their lower ends immersed in water, which is supposed to wash out the oil and allow the steam to pass to its place of exhaust.

A fourth method makes provision for the steam exhausted from the engines to be projected upon the surface of a large tank of water, where the oil attaches itself to the water surface, while the steam is allowed to pass on to its point of exhaust. The fifth method allows the steam with its charge of oil to be condensed and then carried to a skimming tank, where the oil is supposed to rise to the surface of the water and float off, while the cleared water is drawn from a point some distance below the surface. In the last of all the methods purification is effected by passing the oil-charged condensed steam through various filtering mediums, such as blankets, sponges, straws, excelsior, etc., and depending upon their oil-retaining properties to clear the water of its contained oil.

Recently a new process has been devised which provides for the introduction into the water of a small percentage of a special material, the nature of which is at present a secret, which has a great affinity for oil. As this material is stirred throughout the condensed steam, it takes up the oil in the same way that blotting paper takes up ink. Tests thus far made show that the separation of oil from water by this process is absolute and complete.

Oil is present in exhaust steam in three different forms: first, as a vapor; second in finely subdivided particles of oil; third, in the form of a coating around the small particles of condensed water existing in exhaust steam. In all of the processes of oil separation, excepting the last described, it will be seen that it may be possible to ensnare and filter out the finely divided particles of oil floating in the steam and also the minute particles of water with their oil coating, but it is difficult to take care of the vaporous portion of the oil, which has proved most troublesome to the users of such devices. When oily steam is condensed, oil is found existing in the resulting water as a free oil, little clots of which, either separately or combined, float to the surface of the water.

Few persons understand the exact nature of the emulsion, but if a sample of the emulsified oil and water be placed under a powerful microscope and a polarized light be thrown through it, one will see an enormous number of small globules of water having their outer surfaces coated with the thinnest imaginable films of oil showing beautifully iridescent, as the rays of the polarized light pass through them.

Almost any one has noticed the effect of a drop of oil falling upon the surface of water. This drop may be very minute, but it will extend over a large surface of the water, forming a film so thin as to be almost immeasurable. With a million of little globules of water carrying such a thin film of oil upon their surfaces, it is no wonder the oil is difficult to filter off, especially when one considers the great tenacity with which oil clings to the surface of water.

Conceiving the idea that a substance might be obtained which would have a greater attractive force for the oil than the surface of water, the inventor of the new process discovered the material already mentioned. So effective is this material that the quantity used for oil extraction is but one-twentieth of one per cent of the weight of the water itself, and after being introduced into the water, it has proved so light and feathery that a little stirring causes it to diffuse itself throughout the volume of oily water. This extreme lightness and ability to diffuse itself throughout the water soon causes the material to get in contact with all of the oils, which seems to leave the water suddenly and attach itself to the material. Thus, in a few minutes the water becomes cleared and all that is needed to produce a liquid as clear as crystal is a rapid filtration of the oil and water with its contained oil-absorbing material. Samples of water obtained from various power stations and subjected to this treatment have shown no trace of oil in the filtrate when analyzed by the most delicate chemical means. The material has such a capacity for oil that it can be used several times before a new charge is required and, further, the cost of the original material is small.

[1] Abstract (*Engineer*) of a paper read before the American Society of Refrigerating Engineers.

The Railway System of the Sernf Valley, Switzerland.

By Franz Koester.

TO SECURE better communication between the towns of Elm and Schwauden in the Sernf Valley, Canton of Glarns, Switzerland, an electric railway system was put in operation in August, 1905. On account of the numerous curves and grades in this mountainous district, the former in some cases being as short as thirty-five to sixty-five feet radius and as it was desirable to have no curves of a radius smaller than 160 feet, it was necessary to do a large amount of cutting and filling. Besides this a number of sections of the streets were built on made ground, with walls three or four feet high, by the land-owners. As some of these streets were only seventeen feet wide and in many instances retaining walls had to be repaired, the process of laying the tracks proved no small undertaking. In some cases the roads had to be widened up to twenty-three feet. As the tracks were built on the side of a mountain down which much snow fell during the winter, they were built as close to the valley side of the street as possible, in order to facilitate the removal of snow from the tracks by merely pushing it into the valley. In a good many cases, however, as stated above, the two tracks took up the entire road. Eleven small bridges were built of iron and stone, some of the spans running up to sixty-two feet. Proper drainage was secured by small transverse tunnels emptying into the valley.

The rails are of the flange type in cities and street crossings, while at other points they are of the Vignoles type, laid in lengths of fifty feet and weighing fifty-five pounds per metre. All joints are suspended with iron fishplates on both sides. Iron ties are used throughout. As is common on the Continent, the road had to be protected by fences, there being 2.16 miles of iron and 5.5 miles of wooden fencing.

As the whole system was installed with the idea of keeping the first cost down to a minimum, the car barns and other buildings are correspondingly simple. For the accommodation of the power plant, storage battery, car barns, etc, an old factory was altered. In Engi-Hinterdorf and Matt restaurants were equipped independently from an inn and waiting room. In Elm there has been erected a waiting station, freight house and car barn with two tracks, provided with cleaning pits.

The passenger cars are arranged for second and third-class fares, the former having a capacity of six and the latter

SERNF VALLEY RAILWAY SYSTEM—FREIGHT MOTOR CAR. CAR BARN AND PASSENGER CARS. NEW BRUMBACH BRIDGE. INTERIOR OF CAR BARN.

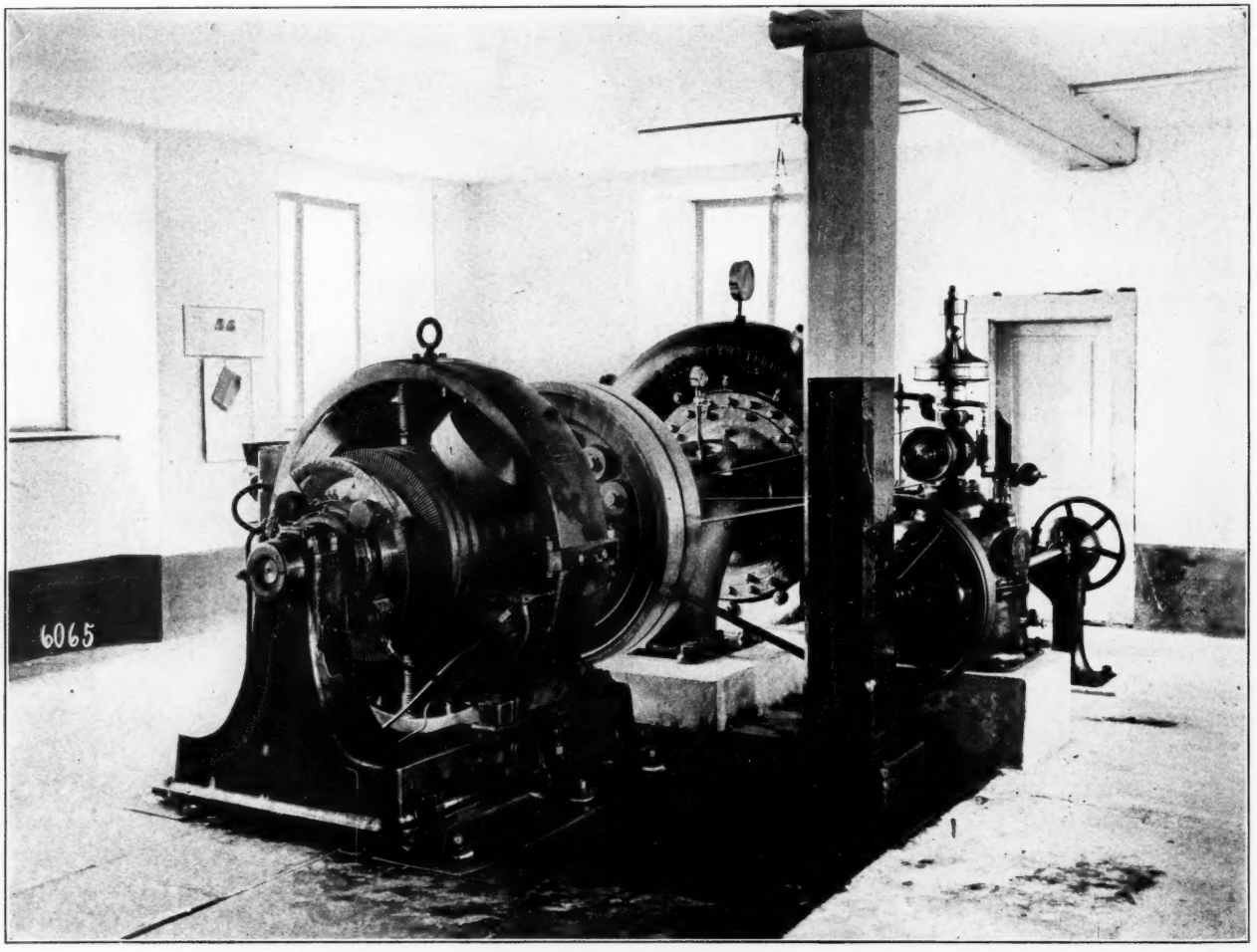
twelve seats with an additional room for twelve standing. The second-class passengers enter at the middle of the cars, which are thirty feet long and have two axles thirteen feet apart. There are also a few trailers, also with two axles thirteen feet apart, which have seats for forty passengers. There are a number of freight cars, some of the box and some of the flat type. The two-axle type of cars was chosen, as the company did not wish to operate heavy cars in the winter on account of the light traffic. The cars themselves were built by the Augsburger and Nürnberger Maschinenfabriken, while the electrical equipment was supplied and installed by the Oerlikon Company, of Zurich, Switzerland. The cars are equipped with two sixty-five-horse-power motors, and as they are light in weight a speed of from eleven to twelve miles per hour is reached on the steepest grades, while on the level an average speed of fifteen miles per hour is easily maintained.

A series-parallel system of control is employed, and one motor alone may be operated. An electric solenoid brake is used. An automatic cutout switch is mounted on each platform and may be thrown by hand. Fuses are also installed as an additional precaution. Each motor-car is equipped with two sliding bows and an air-brake on the Boecker system, the sand-box being pneumatically operated. The air-compressor is mounted directly against the motor frame and is driven by spur gearing from the main motor axle.

For the operation of this railway a small plant was erected near the road, and the water of the Muehlebach was utilized. The maximum water supply available is 2,100 cubic feet per second, while the minimum is 175 cubic feet per second, with a head of 138 feet.

The supply water is led through a small tunnel, 165 feet long, to a collecting basin which is equipped with screen sluice-gates and overflow. From here a penstock 1,836 feet long and 3.28 feet in diameter leads down the mountain slope to the power-house, while the tailrace discharges in the stream Sernf, 230 feet away.

There are at present two vertical spiral turbines of 680 revolutions per minute, generating 200 horse-power each. Each turbine is direct-connected to a continuous-current generator of the Oerlikon type, the turbines themselves being manufactured by Theodor Bell and Company, of Kriens, Switzerland.



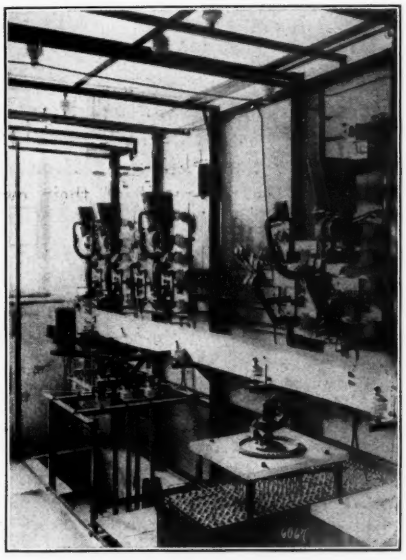
SERNF VALLEY RAILWAY SYSTEM—INTERIOR OF POWER PLANT.

The turbines are provided with delicate governor mechanisms and an oil cataract working upon a servo-motor.

The generators are rated at 135 kilowatts at 800 volts and are of the four-pole, shunt-wound, interpole type, there being four auxiliary poles located between the main poles. The general appearance of these machines is well shown in the illustration herewith. A storage battery of 200 ampere-hours capacity has also been installed.

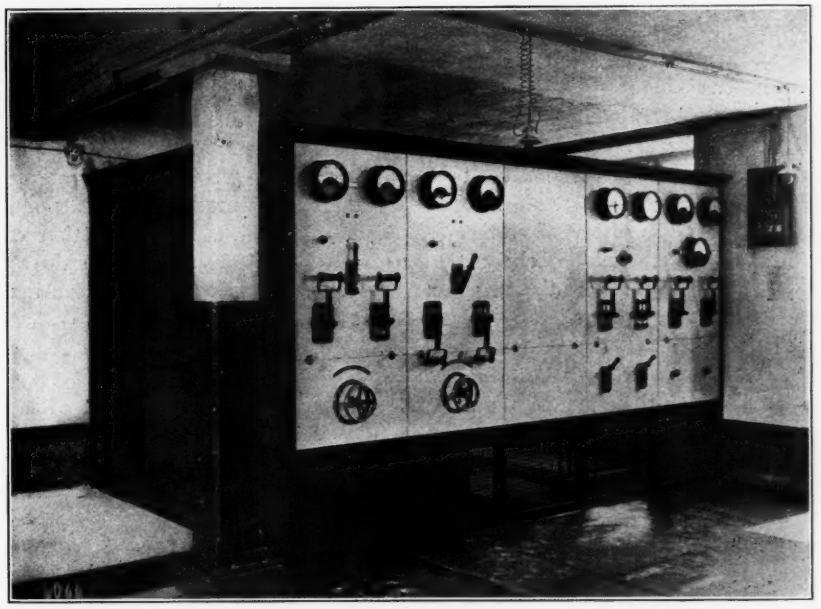
The switchboard consists of five panels, three for generators, one being spare, one

for the battery and one for the feeders. A voltmeter, an ammeter, two switches and a rheostat hand-wheel, together with a carbon switch, are mounted on each



REAR OF SWITCHBOARD, SERNF VALLEY RAILWAY SYSTEM.

generator panel, while an automatic cut-out switch is mounted on the generator. On the battery panel are mounted an ammeter, a voltmeter and two switches, one being an automatic cutout, and a hand-wheel for charging and discharging the



SERNF VALLEY RAILWAY SYSTEM—SWITCHBOARD.

battery. The battery is divided into two parts, connected in multiple on charging and in series when discharging. The last panel is devoted to the feeders. An ohmmeter is so connected on this panel as to make it impossible to close any switch on whose circuit there is a dead ground.

As the power plant is connected directly on the side of the car barn, there is also a repair shop handy.

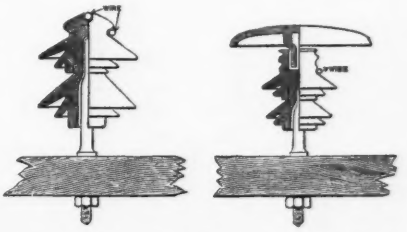
The trolley wires have a section of fifty square millimetres and are carried on wooden poles suspended from wrought-iron pipe brackets. In the direction of Elm a feeder system of 4.2 miles is run, consisting of copper wire, seventy square millimetres in cross-section. On account of the heavy snow-storms which frequently occur in the valleys, the poles are placed only 100 feet apart.

As will be seen, this road operates at infrequent intervals in a very sparsely settled district, where, while it is the only available means of locomotion, the demands made upon it are not great, and therefore it was necessary to employ the cheapest material possible consistent with satisfactory operation.

A New Italian Insulator.

A new Italian insulator designed by Signor Guido Semenza is being shown at the Milan (Italy) exhibition. One of the troubles encountered in high-tension plants in Italy has been the breaking down of the insulators during heavy rains. To guard against this trouble it has been usual to make the upper petticoat with very large diameter to enable it to protect the lower part of the insulator. The conductor is carried on this head. This necessitated making the whole of this petticoat of the same insulating material which forms the chief part of the insulator, and it had to be made with just as much care as the lower petticoats. This type of insulator is shown in Fig. 1. The recent tendency to increase the working pressures has made it necessary to increase correspondingly the diameter of the upper petticoats, which resulted in a great increase in cost. It was to get over this difficulty that Signor Semenza designed the insulator shown in Fig. 2, which is taken from the *Electrical Review* (London), August 31.

In this insulator the wire is fastened below the upper petticoat. It is therefore unnecessary for this petticoat to be strong enough to resist perforation; it need only be watertight and sufficiently hard to resist mechanical shocks and rough usage in transportation. It is therefore made of a form of terra-cotta, which is neither so costly nor so breakable as porcelain or glass. Since the point of attachment of the wire in the Semenza type is somewhat lower than that in the old type, the strain moment of the wire is greatly reduced, which makes allowable a reduction in the thickness of the insulator and in the diameter and cost of the iron bolt; and since this upper petticoat or umbrella is not connected in any way with the pin, complications due to increased capacity are avoided. It is found possible to use a much lighter insulator of the Semenza type in order to secure the same breakdown voltage.



FIGS 1 AND 2.—A NEW ITALIAN INSULATOR.

It is claimed that there is a saving of from thirty to forty per cent for an equally safe installation by using the Semenza insulator, with pressures from 35,000 to 50,000 volts. For higher voltages up to 80,000 or 90,000 it is thought that a saving of fifty per cent will be effected. One of the reasons for the excellent performance of this insulator is said to be the fact that the wire is at no time in touch with the stream of water running over the surface of the effective petticoats of the insulator.

THE RECENT CONTROVERSY ON RADIUM.[1]

BY F. SODDY.

The recent correspondence on the subject of radium, started in the *Times* (London) by Lord Kelvin, has, after lasting nearly a month and causing widespread interest, apparently closed without any very definite conclusion being reached. Whatever opinion may be formed of the merits of the controversy, all must unite in admiration for the boldness with which Lord Kelvin initiated his campaign, and the intellectual keenness with which he conducted, almost single-handed, what appeared to many from the first almost a forlorn hope against the transmutational and evolutionary doctrines framed to account for the properties of radium. The weight of years and the almost unanimous opinion of his younger colleagues against him have not deterred him from leading a lost cause, if not to a victorious termination, at least to one from which no one will grudge him the honors of war. If peace and tranquility now result, and a measure of agreement is arrived at between conflicting views, it will be a result which all concerned will heartily welcome. The most ardent believer in the truth of the new doctrines can not be other than satisfied that every feature and assumption that is admittedly speculative should be clearly recognized as such and separated from that which is not, if thereby the experimental foundations of the science of radioactivity are freed from further wordy and unprofitable controversy. There seems now to be a reasonable prospect that this has been secured.

Lord Kelvin's opening challenge (August 9) was broad and sweeping. He took exception to the statement, made by the writer in opening the discussion on the evolution of the elements at the British Association at York, that the production of helium from radium has established the fact of the gradual evolution of one element into others, and denied that this discovery affected the atomic doctrine any more than the original discovery of helium in cleveite. The obvious conclusion was that both cleveite and radium contained helium. He also stated that there was no experimental foundation for the hypothesis that the heat of the sun was due to radium, and ascribed it to gravitation.

The challenge was taken up on the other side successively by Sir Oliver Lodge, the Hon. Mr. Strutt and other well-known authorities, and it soon became apparent that for argument, at least, Lord Kelvin on his side had to rely practically on himself alone. Professor Armstrong, it is true, immediately enrolled under Lord Kelvin's banner, and entered the lists with an embracing criticism of physicists in general, whom, he declared, are strangely innocent workers under the all-potent influence of formula and fashion. He made the statement that no one had handled radium in such quantity or in such manner that we can say precisely what it is, and throughout put the word radium in inverted commas.

Whether or no his opponents are all as innocent and ignorant as Professor Armstrong imagines, the fact remains that, except for this *ex cathedra* utterance and a leading article, argument against the accepted view there was little or none except that contributed by Lord Kelvin himself. Professor Armstrong's letter merely served to provide Sir Oliver Lodge with justification for his favorite theme, which appears to be that whereas chemists have an instinct of their own for arriving at their results, reason is the monopoly of the physicist, whose results the chemist usually manages to absorb in the end. No better argument against the unfairness of this could be provided than by the history of radioactivity itself, which owes at least as much to the chemist as to the physicist. Professor Armstrong is almost alone among chemists, as Lord Kelvin is among physicists, in his hostility to the new doctrines.

Mr. Strutt in two letters (August 9 and 21) asked what became of the heat generated by the radium admitted to be present in the earth, and recalled the independent evidence of several workers of the continuous renewal of helium from radium. Sir Oliver Lodge directed attention to the magnetic reflection of the α-particle as evidence that material particles are expelled from radium, and in his letter laid perhaps undue weight on the evidence, which is still far from complete, that the α-particle is an atom of helium. The vagueness of this argument, and the fact that the letter raised a doubt whether Lord Kelvin had sufficiently examined the published evidence, a doubt which Lord Kelvin himself promptly dispelled, was the subject of a leading article in the *Times* of August 18. The writer of that article attacked the evidence for the production of helium from radium, using some well-known arguments. The minute quantity of emanation was graphically likened to a bubble rising through a glass of whiskey and soda, and it was held that the results were vitiated by the well-known changes the spectra of gases undergo under the prolonged action of the current, due to occlusion by the electrodes and selective conduction rather than to any transmutation. It may be here remarked that the same arguments were set forth in full by Himstedt and Meyer as a preliminary to their experimental examination of the question, yet Himstedt and Meyer, as the result of their own experiments, were finally forced to the conclusion that helium is in fact produced from radium.

Lord Kelvin in his replies (August 20 and 24) made it clear that he accepted as a fact the continuous evolution of helium from radium, and this admission narrowed very much the issue involved. In reply to a statement of Strutt that if all the helium is removed from radium after an interval a further supply can be extracted, Lord Kelvin remarked simply that the "if" of the statement was wrong. This point was dealt with by the present writer (August 31), who considered the argument could be definitely answered. For helium is produced from the emanation of radium, about which no question of its being really reproduced can exist. For the removal of the emanation is marked by changes in the radioactivity, notably by the β rays, which vanish when the emanation is removed. The recovery of the radioactivity occurs at a definite rate, and is concomitant to the reproduction of emanation, which can at any time be again extracted as before. As there is no question of the radium creating helium, the only point open for argument is the exact character of the decomposition by which it and the emanation which gives rise to it are formed. As there was no further reply to this criticism, it may be taken that the main point of the disintegration theory, that there is a continuous change in the radioactive matter accompanying the radioactivity, is unanswerable.

On the important question as to the character of the decomposition by which the helium is formed, Lord Kelvin in his later letters favored a view very different from that of mere occlusion, which the original analogy to cleveite suggested. He quoted a statement of Professor Rutherford in favor of regarding radium as a chemical compound of helium and other elements, and suggested that radium might be made up of one atom of (?) lead and four of helium. In a final letter (September 4) Sir Oliver Lodge pointed

[1] Reprinted from *Nature*, September 20.

out that this was the key of the position. Is radium a compound or an element? It is satisfactory that, after so much fencing with the question, so simple an alternative has been arrived at. Perhaps the most significant thing about the view that radium is a compound is the silence of the chemists. Surely a chemist might fairly be supposed to know whether a change is what is called a chemical change or not, and the fact that it has been left to a physicist to adopt this view seems fair comment. Not even Professor Armstrong has yet accepted it.

On the second point of his challenge, the denial that the heat of the earth is due to radium, Lord Kelvin naturally had an easier task, for matters connected with the interior of the earth must necessarily remain speculative. If radium did not decompose under the conditions prevailing in the interior it would emit no heat, and would not tend to diminish in quantity, accounting perhaps, although with some difficulty in view of the wide distribution of radium in surface rocks, for the continued existence of the substance at the present time. A. S. Eve, in a vigorous letter (August 28), stated that he had confirmed the estimate of Mr. Strutt of the amount of radium in the earth's crust by a new method, in which the penetrating radiation from the earth's surface was used as the basis of measurement. Although, of course, in view of the evidence of the independence of radioactive changes upon their environment, it is more of an assumption to suppose that in the interior of the earth radium does not decompose than to take the opposite view, yet clearly here, at any rate, there is plenty of room for legitimate differences of opinion. On the other hand even the opponents of Mr. Strutt's view can not deny the potentialities of radioactivity, and the part it might play in cosmical processes under favorable conditions.

The theory that radium is a compound, waiving the qualification chemical, will no doubt serve sufficiently well for the present as a point of common agreement. As Sir Oliver Lodge remarked, there is no necessity that the question be settled offhand. As a stepping stone to further conclusions, it offers advantages to the conservative and cautious. It expresses a bare minimum of established fact which even the most sceptical are unable to invalidate. This minimum, briefly stated, is that radium is undergoing a continuous change intimately connected with its radioactivity, and that in this change helium is produced, and an enormous but definite amount of energy liberated. Whether anything more is known about transmutation now than formerly, whether lead could change into gold or gold into silver with an emission of energy similar to that evolved from radium, whether this or similar energy plays the large share that has been attributed to it in cosmical processes, are questions which may be legitimately discussed and left open, if only for the reason that they are far from decided. They are all admittedly steps into the region of hypothesis.

But what a miserable fraction, even of the known facts, this minimum is! Ostensibly an explanation of radioactivity, it begins and ends with the fact of a gradual evolution of helium from radium. The numerous other products of radium, the volatile emanation and its non-volatile products, known by their characteristic radioactivity, much as minute quantities of ordinary gases and solids are known by their characteristic spectra, the slower-changing later products, of which polonium is one, and is chemically as reminiscent of tellurium as its parent is of barium, remain still to be systematically accounted for. On the important subject of the nature of the α, β and γ rays, and their origin, the view is silent! The fact is ignored that radioactivity is, to use Mme. Curie's happy expression, an atomic property, that is, is independent of the particular state of chemical combination of the radio-element. Radium resembles in the closest possible manner barium, a completely inactive element in the same family, of the periodic table, both in chemical nature and in the series relationships of its spectrum. Barium is an element, radium is a compound; but whether uranium and thorium are elements or compounds is undecided. Again, the emission of energy, greater a million-fold than that evolved in any previous material change, remains a mystery in company with the discrepancy between the physical and geological estimates of the age of the earth. The constancy of ratio between the quantities of radium and uranium in all natural minerals is another experimental fact unexplained.

It is the glory of the accepted view that it harmonizes and correlates all the preceding problems, offering a simple and unstrained physical explanation of each, capable of being tested by quantitative experiment. In addition, it reaches out in every direction in broad, bold predictions, a few of which, like the production of helium from radium and the constancy of ratio between uranium and radium in minerals, have been brilliantly confirmed by experiment, while the majority simply await more refined experimental methods of attack. Of what other theory could the remark be made, which is attributed to Professor Rutherford, that when a single experimental fact is established which does not conform to the disintegration theory it will be time to abandon it? The theory would have to be fundamental indeed to pass this test.

The secret of the vague hostility to the new doctrines which the recent controversy has shown to be widely felt is to be found probably in the impossibility of forming from words or reading the least idea of the really startling character of some of the new discoveries. This is particularly true of perhaps the most wonderful of them all, the radium emanation. Even Lord Kelvin in one of his letters speaks vaguely of emanations, while Sir William Crooks, at least until quite recently, employed the word, also in the plural, as a generic term for the radiations. Give a scientific man a few milligrams of radium in solution and ask him to perform for himself some of the stock experiments with the emanation, for example, its condensation by liquid air, the concentration on the negative electrode of the active deposit formed by it, the steady decay of its powers after removal from the radium and the growth of new emanation by the radium, kept, let us say, in another building or another country; then the radium emanation passes from being a phrase to a fact which no theory can safely ignore. The same is equally true of thorium X, radium C and the numerous other successive products of radioactive change.

It would be a pity if the public were misled into supposing that those who have not worked with radioactive bodies are as entitled to as weighty an opinion as those who have. The latter are talking of facts they know, the former frequently of terms they have read of. If, as a result of the recent controversy, it has been made clear that atomic disintegration is based on experimental evidence, which even its most hostile opponents are unable to shake or explain in any other way, the best ends of science will have been served. The sooner this is understood the better, for in radioactivity we have but a foretaste of a fountain of new knowledge, destined to overflow the boundaries of science and to impregnate with teeming thought many a high and arid plateau of philosophy.

THE USE OF THE TELEPHONE IN THE PERMANENT SEACOAST DEFENSES OF THE UNITED STATES.

BY M. C. SULLIVAN.

As the telephone has revolutionized methods of communication in social and commercial life over a goodly portion of the civilized world, it is not at all surprising to find it rapidly revolutionizing the methods of communication in the seacoast defense service.

The change that has been brought about in the permanent seacoast defenses of the United States by the use of the telephone and other electrical devices in the last fifteen years is marvelous. No similar period in the history of these defenses provides a record of such progress. Not only is this period far beyond previous times in the vast engineering improvements effected, but it is an era which is doing more for the final banishment of war from the civilized portion of the earth than anything that was done in all the years during which organized armies have figured as essential elements of national development.

As the result of electrical methods of communication the old romantic pictures of smoke beacons by day and bonfires by night have passed out of use for signaling purposes, as the old smooth bore gun and the wooden frigates have as destructive engines of war.

It is no exaggeration to state that never before in the history of the world has rapid means of transmitting intelligence assumed the importance in relation to national defense as it has to-day. Because of the increased speed and greatly condensed destructiveness of modern ships of war, it is more than likely that the smallest delay in the transmission of orders or information may determine the result of an engagement or indeed decide the fate of a nation.

As minutes are nothing in seacoast defense operation, the unit of time being the second, it goes without saying that every division of the fort must at all times be within constant and reliable communication with the fort commander, in order that in preparing for action and during action he may be in such close touch and control as to direct every detail and issue and notify commands throughout his entire zone of operations as the exigencies of action may dictate.

The telephone in skilled hands makes it comparatively easy to accomplish this for the far-trailing stations stretched along the edge of the sea guarding against surprise and linked to each other and the forts form an unbroken line of communication. Thus the isolation of the coast has been dissipated by the telephone as wireless telegraphy has done it on the ocean, so, that the men at the guns instead of being compelled to spend hour after hour on duty guarding against surprise in the uncertainty that the next minute may be the critical one which tends to diminish their fighting efficiency are enabled to husband all of their power for the crucial test.

THE USE OF THE TELEPHONE IN PERMANENT SEACOAST DEFENSE.

The one great advantage which the new guns mounted on disappearing carriages in modern implacements have over those on ships is the accuracy of which they can be fired either by night or day. It is estimated that without an adequate range-finding system these guns would be deprived of two-thirds of their value by day and of all or nearly all their value at night.

The poor showing made by the Russian coast artillery guns at Port Arthur against the Japanese fleet is explained by quoting from Marteshev, the Russian general of artillery, that when the ranges were 10,000 or 12,000 metres his artillery did not shoot at all, or at best fired without results. With our system of range-finding it would be impossible for hostile vessels to remain at 10,000 or 12,000 metres from our batteries of twelve-inch guns or mortars for two or three hours and not be destroyed.

The system of range-finding and fire-control used in our coast defenses is of interest to the electrician, inasmuch as its successful operation is entirely dependent on electrical methods of communication.

The general plan or layout of the "horizontal base range-finding system," which enables the guns to be fired with such effective results at extremely long ranges, requires two points of observation located at considerable distance apart, the distance between the two points forming an imaginary base line at each end of which observers with azimuth instruments, as illustrated herewith, make simultaneous observations on the same target. The length of the base line being known and the angles at which the target is observed read from the azimuths, the data for a triangle is secured and worked out as follows: At the primary station is located a large plotting board on which the waters it is intended to control are laid down to scale. On this board, at each point corresponding to the two range stations, movable arms are pivotly attached. The stations being connected by telephone enables the reading from the secondary station to be transmitted to the plotting board so rapidly that a miniature triangle is formed, and the apex of this

triangle is of course the exact position of the target.

In actual practice an operator stands beside the plotting board with his hands on the arms which correspond to the primary and secondary stations. At the instant the reading comes from the secondary station over the telephone he merely swings the "secondary" arm to the angle indicated. The angle of the primary instrument being read off, he performs a similar function with the "primary" arm. The intersection of the two arms gives the exact position of the target at a glance; this operation is repeated every twenty seconds for one minute. The three readings serve to give the course of the target and its speed. At times more readings are taken, but such is the accuracy of the work that three readings usually suffice.

A Field Party Using Telephone in Conjunction with Plotting Board.

The target being located, the guns are directed by telephone from the plotting board, the degrees in azimuth and range only being given, unless it should be necessary to add other tactical information.

When the guns are laid in accordance with instructions given they are fired by the battery commander from his station near the plotting board.

As might be expected, there is little of the so-called glory of war in this kind of fighting. The romance and picturesqueness of standing at the guns exposed to the enemy's fire inviting the soldier to brave and valiant conduct has been superseded by the exact requirements of electricity and mechanism.

To the humanitarian who hopes for the final banishing of war from the earth there is something pleasing to contemplate in all this improvement, for the more scientific war becomes, the less interest it is liable to possess for the majority of mankind, for the war spirit of all time past has been rendered attractive to man generally because of the sense of adventure, the romance of glory to be won through individual achievements, and the pomp, circumstance and uncertainty heretofore inevitably incidental to its prosecution.

Wireless Telegraph Work in Reporting the Roosevelt Cup Races.

During the recent races for the Roosevelt cup, off Halfway Rock, Marblehead, Mass., the Stone system of wireless telegraphy was utilized by the Associated Press, the Publishers' Press and several Boston and New York newspapers, with distinguished success. Arrangements were made with the Stone Telegraph and Telephone Company to install wireless sets on the Eastern Yacht Club committee's tug Mercury and in the yacht clubhouse at Marblehead. Apparatus of a semi-portable description was furnished by the Stone company, and installed in these two places in approximately two days' time. The Mercury was equipped with two flagpoles approximately twenty-five feet high and thirty feet apart. A horizontal antenna, consisting of ten wires eight inches apart, was suspended between the two masts and brought down into the engine room, where the wireless apparatus was temporarily located. Power was furnished by a 1.5-horse-power Holtzer-Cabot alternating-current generator giving sixty cycles and 110 volts. The voltage of this generator was cut down by resistance in the field until it delivered approximately 200 watts direct to the primary coil of the high-potential transformer. At the Eastern Yacht Club house a fifty-foot mast was erected and placed seventy-five feet from the automobile garage, in which the temporary apparatus was located. Two widths of chicken netting, six feet wide and seventy-five feet long, were brought from the top of this mast to the roof of the garage, which was approximately twenty-five feet above the ground. Ground connection was provided by spreading two widths of chicken netting on the ground under the elevated area, thus giving an electrostatic connection with the earth. The power used in the yacht club station was supplied by the Marblehead Electric Lighting Company, being the ordinary 110-volt, sixty-cycle alternating current employed for town service. The Western Union and Postal Telegraph lines were run into the Eastern Yacht Club house to handle the press work and were in close proximity to the wireless telegraph set. During the time that the races were under way the Boston navy yard station, which was approximately fifteen miles distant, was doing considerable business with the Portsmouth navy yard station and the Cape Cod station, and also with warships which were at times within five miles of the race course. The average distance of the committee's tug from the yacht clubhouse was twelve miles. The navy department at its stations had a wave-length of 450 metres. The tug, yacht club and the experimental Stone station at Cambridge, twenty miles distant, were set on a wave-length of 300 metres. Under these circumstances it was found that at no time was there any interference with either the navy department or with the yacht club and the tug, owing to the high degree of selectivity of the Stone system.

The features of this service were the high speed which was maintained and the use of a device developed by Sewall Cabot, superintendent of the Stone Company, whereby the receiving operator may instantaneously interrupt the sending operator in case of a failure to get a word or a figure correctly. The method employed is for the receiving operator to repeat the

letters B K, followed by the first letter of the last word correctly understood. The sending operator hears part of the letters B K at some time when his key is up between the dots and dashes transmitted, and this is a signal for him to stop transmitting and to listen to what the receiving man wishes to say to him. It is in exact analogy in the working out from a traffic standpoint with the manner in which traffic is handled for a duplexed wire circuit at the present day.

The service was speeded up so that it was possible for traffic to be put through at a rate such that at no time was a reporter's copy held up over ten minutes, due to matter which had been previously filed and not sent. The reporters who were writing running stories of the race as it took place filed their copy in amounts averaging about eighty words, and in this way it was possible to deliver running stories of the race at the newspaper offices in Boston and New York at times which averaged about twenty minutes from the time at which the event reported actually occurred. In the case of turning times, which it was very important for the papers to get quickly for the purpose of bulletins, these were given "flash" preference and were delivered to the newspapers approximately three minutes after the noted times of turning.

At no time during the race was the wireless service out of commission, even for a period as long as one minute. The largest number of words sent at one time was 4,120, on September 8. The total average words sent per minute was 22.9, and the average actual number of words, as shown by numerous five-minute tests, was twenty-four. The maximum average number of words per minute was thirty-three.

Illuminating Engineering Society.

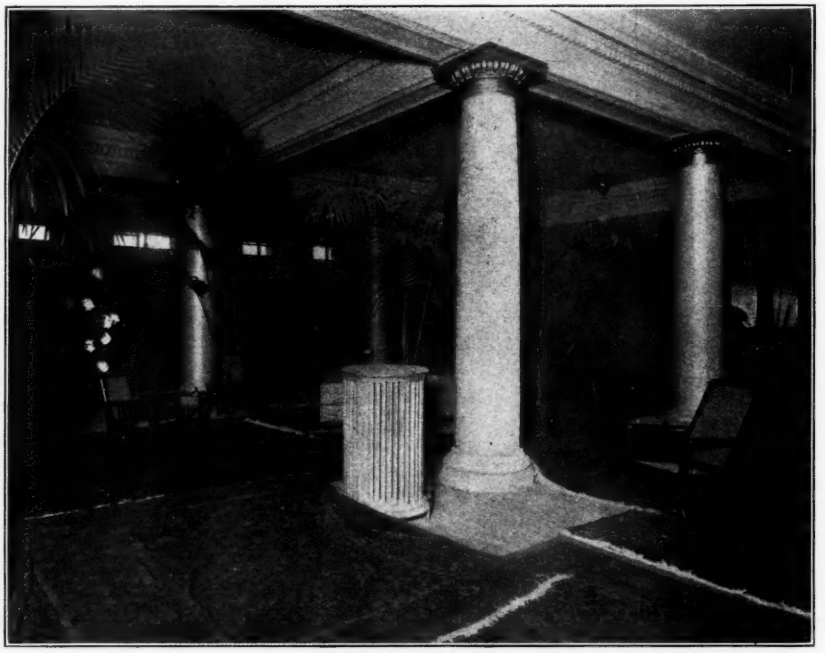
A meeting of the Illuminating Engineering Society will be held in the Edison Auditorium, 44 West Twenty-seventh street, New York city, at 8 P. M. Friday evening, October 12. Two papers will be presented on the general subject of "Data of Indoor Illumination," one by J. E. Woodwell, inspector of electric lighting plants, United States Treasury; and the other by E. C. White, illuminating engineer, Winnipeg, Manitoba.

At this meeting the membership of New York city and vicinity will be organized as the New York section of the society.

The membership of the society now exceeds 600, and sections have recently been organized in Philadelphia and Pittsburg. The above-mentioned papers will be presented before these sections and before the Chicago and New England sections of the society, which were organized last spring.

The Telharmonium Demonstrated before the New York Electrical Society.

The two hundred and sixty-first meeting of the New York Electrical Society was held at No. 1414 Broadway, New York city, on the evening of Wednesday, September 26. The feature of the evening was the first public Cahill telharmonium concert. The beautiful reception room which the New York Electrical Music Company has provided was the scene of a very lively gathering of ladies and gentlemen, and during the subsequent demonstration of the remarkable powers of this instrument many expressions of appreciation and commendation were heard.



PARLOR WHERE TELHARMONIUM DEMONSTRATION IS CONDUCTED. THE RECEIVERS ARE LOCATED IN THE HANGING CLUSTER IN THE FOREGROUND AND IN THE FLOWERING CLIMBER IN THE BACKGROUND.

The new president, G. Herbert Condict, called the meeting to order, and in a few words introduced the subject of the evening and its exponent, Oscar T. Crosby. Mr. Crosby, said the president, when he last appeared before the society, had addressed the meeting as an explorer returned from a comparatively unknown land—far-away Thibet. At this time, however, Mr. Crosby would present another subject dealing with an exploration into a hitherto undiscovered realm. For the telharmonium system Mr. Condict predicted a remarkable development, and emphasized his belief that it would take its place as one of the notable electrical contrivances of the age.

Mr. Crosby's address abounded in wit, humor, technique and lucid explanation. Notwithstanding the crowded condition of the room, it being necessary for a great number of those present to stand during the entire evening, the graceful manner in which Mr. Crosby delivered his remarks took away the tedium of waiting for the musical demonstration to begin. Mr. Crosby explained, for the benefit of the non-technical who were present, the phenomena of the telephone circuit, showing how the voice tones acting upon the diaphragm of the transmitter set up varying currents in the circuit, causing the diaphragm at the receiver to vibrate in unison with the diaphragm at the transmitting end. Even those who were familiar with the telephone as a means for reproducing speech were amazed at the volume and intrinsic clearness with which the musical tones of every register were reproduced. It is the intention of the company to arrange its circuits for multiple distribution, so that restaurants, music halls and other public places, as well as private residences, may be served music of every character, all of which will emanate from a central music station, the analogy of which is aptly represented in the present distribution of electrical energy for incandescent lighting.

Following Mr. Crosby's introduction

and explanation, the following programme was rendered:

Flute
Cornet
Clarinet
Oboe
French Horn
MR. EDWIN PIERCE
Rossini, Oboe Solo from Overture of William Tell
Mendelssohn, Song Without Words. Op. 102, No. 3.
Schumann, Träumerei
Grieg, Humoresque, Op. 6, No. 3
MR. CARL SCHULZ
Haydn, Rondo
MR. HENRY W. GEIGER
McDowell, "Thy Beaming Eyes"
Burleigh, "Jean"
Jamison, "Lullaby"
MISS FLORENCE FISKE
Accompanied by MR. FRANKLIN HARRIS
Illustrations:
Dixie, with fife and drums
Scotch Air, with bagpipes
MR. HAROLD SMITH
Thomé, "Under the Leaves"
Beethoven, Trio, Op. 55
MR. EDWIN PIERCE
Godard, Berceuse
MESSRS. SMITH AND GEIGER
Old Songs:
Ave Maria, Bach-Gounod
MESSRS. PIERCE AND SCHULZ
Goltermann, Andante from 'Cello Concerto
MESSRS. SCHULZ AND HARRIS

At the conclusion of the musical entertainment Professor A. F. Gans addressed the meeting, and on behalf of the New York Electrical Society extended a vote of thanks to Dr. Thaddeus Cahill, the inventor, his brothers, who as co-workers developed this ingenious electrical musical instrument, and to Mr. Crosby, for the excellent entertainment which had been accorded to the members.

Municipal Ownership.

One of the most interesting and instructive papers delivered at the recent Thousand Islands convention of the Association of Edison Illuminating Companies was presented by Arthur Williams, and entitled "Municipal Ownership."

Mr. Williams points out very intelligently the conditions and possibilities which have led up to the present agitation for municipally operated public utilities and the danger that exists unless the proper educational methods are adopted to force back this popular demand. The fact is particularly noted that there has been inadequate presentation of the corporation's side of the argument in seeking to enlighten and win public opinion. The great public has been likened to a jury, which can give a verdict only on the evidence before it. Thus a poor case, fully presented, may prevail over a good one where the presentation is insufficient. One rarely finds "the side of a corporation fully and fairly presented, its cause pleaded or its position explained, the hidden conditions brought to light, the overlooked or forgotten elements of cost revealed, the experience of other communities compared. Were these things done, how different might be the direction of public opinion."

"Public action," says Mr. Williams, "by private corporations should be carefully considered and well directed. It should be united, since the cause of one is the cause of all, and the conditions controlling one surround all. While united and cooperative, it should be individual, personal, direct and local.

"Educational publicity without, and the attainment of higher ideals within, are conceded as the effective ways of meeting this movement. No others are needed, no others should be wanted. Quick, perhaps, to see the defects in others, we should apply a magnifying glass with searchlight rays to our own methods and relations with the public.

"A first essential is that courteous, considerate treatment which the public so thoroughly appreciates and enjoys. Compare what we can do with the brusque indifference of the employés in almost every department and office of a municipality. Our own methods, instead of resembling them, should stand out in marked contrast. The beginning should be with the directors and president and it should extend through the entire organization to the office boy and janitor.

"The quality of the service should be as nearly perfect as modern invention, construction and operation can make it. Bad, indifferent, or poor service should be corrected at any cost. More should be given, not less, than the public has been led to expect. What we are to the public makes good opinion or bad, friends or opponents.

"Good service means not alone the kind of light we supply—it includes everything relating to the affairs of the company. The manner with which poles are erected and wires are strung; with which streets are opened and the pavement again laid; the promptness with which customers' wants are met; with which service interrupted is restored; the convenience and promptness with which the public may become users of electric current.

"The complaint bureau of a public service corporation can not be too highly rated. Every complaint made gives an opportunity to make a new and lasting friend—the kind it pays to have—one who has been cured of a grievance. It is not that a rebate has been made or an employé discharged, but the manner in which the complaint is received and the evidence of careful consideration that counts with the public.

"Another very important consideration is the treatment which private corporations accord to their employés. There is probably little question but that a large percentage of those whose votes must be relied upon in any municipal ownership or socialistic movement are the employés of public service corporations. In 1903 there were more than one million three hundred thousand employés in the service of American steam railways alone; the number is undoubtedly greater to-day. Thus in this single service alone are more than ten per cent of the voters of the country.

"With all other considerations the prices of our companies must be included. Not only should they be as low as circumstances justify, but as simple and as readily understood. Differential are not preferential rates. But this it is sometimes difficult to make the public understand.

"One method of charge for public service—gas and electric—now receiving a great deal of attention might be mentioned—the English sliding scale, recently adopted by the gas companies of Boston. The method seems to contain elements in satisfying the public which no other rate system thus far devised appears to have accomplished. After assuring to the company a fair return upon its investment, and the public a maximum price beyond which it shall not be charged, the further profits are divided in ratios agreed upon, between the public and the company.

"England's municipal indebtedness, according to the last available figures, now amounts to £2,345,000,000 and there is evidence of a strong counter-movement looking to the material curtailment of the functions of the municipalities.

"Lord Avebury in a recent address pointed out that the capital expenditure in the electric lighting undertakings alone now amounts to £27,000,000 upon which last year a 'profit' was claimed of £339,000; that only one per cent was allowed for depreciation, which he called absurd. If as little as two and one-half per cent had been set aside for depreciation, he says, this item alone would have amounted to £673,000 and 'would have turned the so-called profit into a heavy loss.' He also pointed out that of forty-eight municipalities working tramways only thirteen contribute to the rates; seventeen make no depreciation allowance and only eleven make over two per cent."

Trial of New York Central Electric Train.

On Sunday, September 30, a trial was given two of the electric locomotives built for the New York Central & Hudson River Railroad, drawing a train of seven cars through the Park avenue tunnel. Under electric operation it is said that the train moved very smoothly, without jerks or starts, and quickly attained full speed, making the run from Highbridge to the Grand Central terminal without any trouble. The trial was attended by representatives of the New York Central and the General Electric Company, and also by representatives from other railroads.

FUEL, WATER AND GAS ANALYSIS FOR STEAM USERS.[1]

BY JOHN B. C. KERSHAW, F.I.C., ANALYTICAL CHEMIST AND ELECTROCHEMIST.

IV.—Practical Applications of the Test Results.

Engineers who have never made use of the results obtained by laboratory tests of fuel, either in relation to their supplies of fuel or in the working of their boilers, are disposed to be somewhat scornful as to the value of fuel testing to the practical engineer. In their view, the results obtained from steam-raising trials are alone worth depending upon. That this view is superficial and incorrect is proved by the fact that engineers who have adopted fuel testing as an aid in the work of boiler management rarely relinquish it, and as their knowledge of its usefulness extends, they place more and more reliance upon the laboratory test results and less upon the steam-raising trials, in forming their comparative judgments of different fuels. When one remembers that the essential conditions obtaining during steam-raising tests are never exactly the same; that all fuels are treated alike although different fuels demand different methods of firing and different treatment as regards draught, to obtain their maximum evaporative effect; and that the fireman or engineer who is in charge of the boilers may very probably be receiving a bonus or present from one of the fuel-supplying firms, this loss of confidence is not surprising. The value of comparative steam-raising tests as a guide in the placing of fuel contracts, or in the control of the fuel supplies, is in fact greatly overrated, and the larger number of these tests as they are at present carried out are not worth the time and expense entailed in obtaining them.

In the following pages the author will deal with three practical and scientific applications of the test results as obtained in the laboratory examination of fuels, and will show how these can be utilized in:

1. Placing fuel contracts.
2. Controlling the fuel supplies.
3. Checking the evaporative efficiency of the boilers.

1. Placing Fuel Contracts—Contracts for the delivery of large quantities of fuel involving the expenditure of many hundreds of pounds ought always to be based on the laboratory test results, for the reasons already given. The sampling and testing of each sample load of fuel should be conducted as described in articles ii and iii, both approximate and calorific tests being carried out.

If possible a bomb calorimeter should be employed for the latter tests, since in this case the results obtained are reliable for all classes of fuel. Steam-raising tests can, of course, be made at the same time; but the author has given reasons for doubting the value of these unless much more scientifically carried out than is usual at present. The laboratory test results of the various sample loads of fuel are then grouped as shown in Table i. If the contract is to be based solely on cheapness, the decision is easily made by comparison of the figures given in column 10. These figures are obtained by dividing the calorific value multiplied by 2,240, by the price per ton in pence of the fuel delivered in the bunkers. As a rule, however, the percentages of ash and of volatile matter will have some influence upon the choice of fuel. Having eliminated from the list those which are unsuitable owing to high ash contents or to too high a percentage of volatile mater, the selection from those remaining in the list of the fuel which yields the greatest number of calories per penny of cost is an easy matter. Provided that correct conditions of stoking and draught are employed in burning the fuel under the boilers, the fuel which gives the greatest number of calories per penny of cost will prove the most economical in actual use.

That wide variations exist in the value of different fuels when judged by this method is proved by the following figures, based on actual tests and prices:

South Wales steam coals.....
- No. 1, 68,544 calories per penny of cost.
- No. 2, 89,600 calories per penny of cost.
- No 3, 128,128 calories per penny of cost.

Lancashire bituminous coals
- No. 4, 119,168 calories per penny of cost.
- No. 5, 148,512 calories per penny of cost.
- No. 6, 193,088 calories per penny of cost.

The calorie used in this table is the pound centigrade unit; and the above figures must be multiplied by 1.8 to obtain the corresponding value in British thermal units. If burnt under "proper conditions" to obtain the maximum efficiency, it is therefore evident that the coal marked No. 6 in the above list would prove the most economical in actual use, for it yields double the heat units of No. 1 or 2, per penny of actual cost. If burnt in furnaces designed for South Wales steam coal, with a small combustion area, it is, however, possible that this No. 6 coal would not show this superiority; and

TABLE I—APPROXIMATE ANALYSES, CALORIFIC VALUES (CALCULATED AND OBSERVED), PRICES AND COMPARATIVE COSTS OF VARIOUS ENGLISH AND WELSH COALS.

General Description of Coal.	1. Particular Description of Coal.	2. Per Cent Moisture.	3. Per Cent Ash.	4. Per Cent Coke.	5. Per Cent Volatile Matter.	6. Per Cent Fixed Carbon.	7. Calorific Value Observed).	8. Calorific Value Calculated).	9. Price per Ton Delivered in Bunkers. s.	d.	10. Calorific Value per Penny of Cost.
Hard South Wales coals	Standard Merthyr	1.21	8.85	84.50	15.50	75.65	7,942	7,950	21	0	70,784
	Cwmmer Main	1.46	10.00	87.50	12.50	77.50	7,935	7,855	17	3	85,792
	Dynevor Duffryn	1.25	8.10	84.10	15.90	76.00	7,987	8,028	19	1	77,952
	Pontardawe smokeless	2.66	8.40	97.90	12.10	79.50	7,875	7,995	17	3	85,120
	Ocean steam coal	3.13	13.95	87.00	13.00	73.05	7,590	7,511	15	10	89,376
	Loughor & Mynydd Newydd	2.20	17.03	86.00	14.00	68.95	7,360	7,545	9	6	144,480
	Werfa	1.34	14.95	90.00	10.00	75.05	7,331	7,405	11	11	128,128
Soft bituminous coals	North Hetton	2.51	13.80	69.00	31.00	55.20	7,590	7,347	11	10½	119,168
	Bowley washed slack	2.76	5.85	67.40	32.60	61.55	8,365	8,123	10	6	148,512
	Wigan	4.94	16.85	63.90	30.10	53.05	7,192	7,089	8	3	162,624
	Wigan & Skelmersdale	6.76	16.50	71.20	28.80	54.70	7,245	7,203	8	4	162,176
	Digby bright peas	10.44	6.50	63.50	36.50	57.00	7,935	7,703	7	9	191,072
	Shipley peas	7.72	7.75	66.00	34.00	58.25	7,891	7,764	7	11	185,920
	Marchay rough slack	7.80	3.05	64.70	35.30	61.65	8,314	8,214	8	8	178,976
	Manners peas	7.44	10.75	66.40	33.60	55.65	7,675	7,490	7	5	193,088

NOTE—(1) The results in columns 3, 4, 5, 6 and 7 are all based on the sample dried at 110 degrees centigrade.
(2) Columns 7, 8 and 10 give the calorific value in centigrade units.
(3) The first five samples are from a South Coast electricity supply station, and the costs delivered in bunkers are correspondingly high.

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the author must once again emphasize the necessity for adapting the furnace design, dimensions and methods of firing to the type of coal which is to be burned in it, if good results are to be obtained. The discrepancies which occur between the laboratory test results and those obtained in actual practice are due to the neglect to observe this essential condition for obtaining good results under the boilers. The subject of furnace design and control of the combustion process, however, is somewhat outside the scope of this series of articles, and readers must refer to the book named below for an adequate discussion of it.[1]

Having selected a fuel from the small or large number of which sample wagons have been submitted for trial, it is advisable that the contract should be based upon the results of the laboratory tests, and that some kind of a sliding-scale relation between calorific value and price should be arranged. The exact details of this will vary in the individual cases; but the specification reproduced below is an example from actual practice of a fuel contract based on laboratory tests, with such a sliding-scale arrangement between calorific value and contract price of the fuel. The fuel in this case was a South Wales steam coal, delivered at 9*s*. 7*d*. per ton.

SUPPLY OF LARGE WELSH SMOKELESS STEAM COAL.

SPECIFICATION AND CONDITIONS.

1. **Quality—To be large Welsh smokeless steam coal, free from dust, to contain not more than fifteen per cent of small, and to have a minimum calorific value of 13,300 (thirteen thousand, three hundred) British thermal units per pound of coal, as measured by a calorimeter approved by the borough electrical engineer.**
2. **Tests—During the continuance of the contract, tests will be made once every week from samples delivered during that week, and if the mean of four tests during any month show that the calorific value is below the standard, the rate per ton paid to the contractor for the whole of the coal delivered during that month shall be less than the contract price as set forth in the "price schedule" attached hereto.**
3. **Right to Reject Inferior Coal—Notwithstanding condition No. 2, the council reserves to itself the right to reject any portion of the coal delivered, the tests of which show that the calorific value is less than 13,300 British thermal units per pound of coal.**
4. **Engineer's Decision to Be Final—Should any dispute arise as to the accuracy of tests, weights, quantity of dust or small, quality, or other matters whatsoever, the decision of the borough electrical engineer shall be final and binding.**

PRICE SCHEDULE.

Scale of reduction in price for lower calorific value than 13,300 British thermal units.

Per Pound.	At Pit's Mouth.	Delivered.
For a minimum of 13,300 B. T. U., the contract price....	..	9*s*. 7*d*.
Below 13,300 but not less than 13,200, a reduction of 5*d*. per ton.....	..	9*s*. 2*d*.
Below 13,200 but not less than 13,100, a reduction of 10*d*. per ton.....	..	8*s*. 9*d*.
Below 13,100 but not less than 13,000, a reduction of 1/3*d*. per ton.....	..	8*s*. 4*d*.

Clause 4 of this contract is obviously unfair to the colliery company since an independent chemist or fuel expert ought to be appointed as referee in case of disputes. But otherwise the specification has much to recommend it.

Another method of working out the price variation for differences in calorific value has been recently adopted by the city of Chicago in the purchase of 200,000 tons of coal. The standard price in this case was $2.30 per ton of 2,000 pounds for a coal testing 13,000 British thermal units in the undried state. Allowing for the moisture and cost of removing the ash, this worked out to 100,000 British thermal units for one cent. If the British thermal unit per cent came out above or below this limit, the price of the coal varied accordingly; the principle underlying the contract being that in all cases one cent should purchase 100,000 British thermal units of heating value in the fuel. Thus at times the seller, and at times the buyer, was favored by the price variation, and the price asked and paid for the fuel was an absolutely fair one.

The author believes that in time this last-described method of buying fuel will apply to all large fuel contracts. The present method is grossly unscientific and unfair alike to the buyer and seller, and the sooner it is replaced by another the better it will be for all concerned.

In drawing up fuel contracts it would also be well to stipulate that the moisture and sulphur contents shall be kept well within the percentage shown by the test of the sample wagon. Owing to various causes, the percentage of moisture and sulphur in coal and slack may at times rise to a very high figure; and apart from the foolishness of paying from 7*s*. to 10*s*. per ton for this water and sulphur, there is the question of the heat which will be carried off to the chimney when the water is converted into steam in the furnace of the boiler. As regards ash contents, it would also be well to reserve the right to reject deliveries of fuel showing a percentage much above that embodied in the contract. But the increase in ash will always be accompanied by a corresponding diminution in thermal value, and the variation in ash contents is therefore covered by the sliding-scale arrangement based on the result of the calorific tests.

Though the freedom to reject coal below the stipulated thermal value may be reserved to the buyer as in Clause 3 of the contract printed above, in most cases it is least troublesome to accept delivery, and to claim the deduction in price under the sliding-scale arrangement. Otherwise much trouble and expense may be entailed in connection with reloading and railway charges.

2. Controlling the Fuel Supplies—The laboratory testing of fuel can be employed most usefully to check the quality of the supplies of fuel from day to day and from week to week. When the contract has been based upon calorific value, this testing is, of course, essential. If the contract has not been based upon the results of the laboratory test of the sample wagon, no automatic reduction in price can follow should this laboratory examination of the daily and weekly samples yield bad results. But the fact that the deliveries of fuel are being regularly sampled and tested will be known to the colliery company supplying the fuel, and will cause it to be more careful in the selection and sorting of the fuel sent. Complaints also based on the results of laboratory tests will receive more attention than those based merely on firemen's complaints or upon a manager's inspection of the fuel. As already stated, there is good reason to suppose that the firemen and sometimes the engineer in charge have a financial interest in keeping the fuel contract to one particular firm. Therefore, neither their silence nor their complaints can be accepted with any degree of security. Most engineers in charge of boiler plants, when attempting to make changes in their fuel, have experienced the apparent stupidity or obstinacy of their firemen, and have had reason to suspect their impartiality as regards the fuels with which they are conducting trials. Even in the absence of contracts based on calorific value, it is therefore well to have this independent check upon the character of the fuel supply; for a fireman receiving doles or presents from the colliery company is not likely to become very active in complaining of this fuel when the deliveries fall off in quality. As a check therefore upon the supplies, the author advises daily sampling of the fuel either in the wagons and trucks, or during discharge into the storage bins. When sampling fuel in trucks or wagons it is necessary to make allowance for the fact

[1] "Smoke Prevention and Fuel Economy," by Booth and Kershaw.

that the jolting of railway or road transit causes all the fine coal and dust to fall to the bottom of the mass. To obtain a fair sample of coal from a railway truck is therefore a matter of some difficulty, and in most cases it will be easiest to sample the fuel during discharge. Coal conveyed in canal barges, or by river to the works, does not undergo a similar mechanical separation into large and smalls, and in such cases the load of fuel can be sampled if necessary in the barge.

In all cases, however, the fairest sample can be obtained during discharge, and where conveyers and automatic weighing plants are in use, it is a comparatively simple matter to arrange that every fifth, tenth or twentieth bucket shall be tipped into a sample storage bin. If fuel from more than one colliery is being delivered and used at one time in the works, it will, of course, be necessary to have an equal number of sample storage bins.

At the end of each day, the fuel in these bins is crushed and sampled in accordance with the instructions given at the end of Article I, and the one-pound samples are sent to the laboratory or to the fuel expert for examination and test. It will not, as a rule, be necessary to carry through a complete approximate analysis and calorific test as described in Articles II and III, with each of these daily samples; the determination of the moisture and ash in each being sufficient to enable one to check roughly the quality of the coal being supplied under the contract. The daily samples are, however, retained each in their own sample tin, and once a week or oftener an average sample is made up from these by weighing out 50 or 100 grammes of each and by thoroughly mixing the same on the sampling plate or on a sheet of glazed paper. A complete approximate analysis and calorific valuation is then carried out with this sample. Upon the results of these weekly tests complaints to the colliery company as to the quality of the supplies, and the variations in price of the fuel delivered under the contract are based.

A book should be kept for entering up both the daily and weekly fuel tests. The results obtained during the delivery of coal under any one contract will prove of great value in fixing the terms for the next contract. Special samples of single wagons or trucks of fuels that appear to be of bad quality should be taken occasionally, for at times the colliery company may become slack in its supervision of the sorting and cleaning of the coal brought up from the pit and as already pointed out, much dirt and shale can be sometimes sold as fuel. The author has tested fuels containing only six per cent of ash from the same pit that produced slack testing up to twenty-five per cent of ash; and some years ago he was asked to report upon a sample of so-called coal which contained no less than 37.70 per cent of ash.

These figures prove the fallacy of the opinion held by many engineers, that coal from one pit or from one seam is of fixed and unvarying composition when delivered into the trucks; and that it is alone necessary in drawing up fuel contracts to specify the pit or seam from which the supplies are to be drawn.

Fuel, in fact, appears at present to be the only raw material used in large quantities, the sale and delivery of which is still in the majority of instances conducted by rule-of-thumb methods. It is satisfactory to note, however, that in this matter also the methods of the past are being replaced gradually by the more scientific and exact methods of procedure outlined in this article.

3. Checking the Evaporative Efficiency of the Boilers—With the aid of the figures obtained by the calorific test of the average weekly sample of fuel, as described in Section II of this article, it is possible to make out a balance sheet for the working of the boiler plant, and to calculate the evaporative efficiency of the same, with a high degree of exactitude.

By evaporative efficiency is signified the percentage ratio between the total heat value of the fuel, and that utilized in the conversion of water into steam.

The other tests required for ascertaining this efficiency by calculation are those showing the composition and temperature of the exit-gases. The methods of obtaining these will be dealt with in Articles IX to XII of this series; and in this section the method of applying the results will alone be dealt with.

There are four directions in which the heat produced by combustion of fuel in the furnace of a boiler is dissipated.

In the first place, a certain definite and fixed loss occurs by radiation from the exposed surface of the boiler and of the surrounding brickwork. This loss can be roughly ascertained by drawing the boiler fires, closing the steam valve and feed-water valve, entirely cutting off the draught, and by noting the time required for a fall of ten or twenty pounds in the pressure of the steam. As a rule, radiation losses account for from 7.5 per cent to ten per cent of the heat present in the fuel. The figure, when once ascertained for any one boiler, may be used as a constant in all the future heat balance calculations. The second direction in which heat is dissipated or lost in boiler working is with the waste gases passing away from the boiler flues to the chimney. The method of ascertaining and calculating this loss will be described in Article XII of this series. This loss may amount to from ten per cent to thirty per cent of the heat value of the fuel burned.

The third direction of heat loss is by the ashes and cinders. The loss here is twofold, being partly due to the heat carried by the ashes, and partly that due to the unburned carbon in the cinders. Once a week the ashes may be sampled, and the unburned carbon determined by the method used for estimating the amount of ash in the fuel. (See Article II.)

The total heat loss in the ashes and cinders should not exceed five per cent; but it may rise much higher with chain-grate stokers when badly worked, or with untrained firemen and hand-fired boilers.

The fourth direction in which heat is dissipated is through the boiler plates. It is this portion of the heat alone which is the active agent in water evaporation, and gives the evaporative efficiency of the boiler. It is ascertained by adding the three items of loss named above together, and by subtracting the total from the thermal value of the fuel, as determined by the laboratory examination of the same.

The following is an example of this method of calculating the working efficiency of boiler installations:

Fuel—Lancashire slack at 7*s.* 6*d.* per ton delivered in bunkers. Heat units produced per pound by calorimeter test 13,500 British thermal units.

1.	Losses by radiation, etc., ten per cent	1,350
2.	Losses with exit-gases up the chimney (calculated ten per cent CO and gases at 465 degrees Fahrenheit)	2,380
3.	Losses by unburned carbon in cinders and ashes, and heat carried away in same (five per cent)	675
4.	Converted into steam in boilers (by difference)	9,095
		13,500

The efficiency of the plant, therefore, equals 9,095/13,500, or sixty-seven per cent. Items 1 and 3 are based on estimates or upon previous test results; but these two items, under ordinary working conditions, should not vary more than five per cent.

Should the analysis of the exit-gases show that carbonic oxide gas is present, a further entry will be necessary in the

above heat balance, to show the thermal units lost by this failure to burn all the carbon to carbon dioxide. Let us take, as an example of this additional calculation, exit-gases containing two per cent, by volume of CO, and eight per cent CO_2. Since carbon, when burned to carbon dioxide, yields the same volume of gas as when burned only to carbon monoxide, the above percentages show that two-tenths or one-fifth of the carbon present in the fuel has escaped complete combustion. Now, as found by the approximate analysis, the percentage of fixed carbon present in the fuel was sixty per cent, and the thermal units liberated when carbon is burned to CO are 10,201 less than when carbon is burned to CO_2 (4,343 and 14,544, respectively).

The loss of heat due to incomplete combustion, in the case under consideration, is therefore:

$0.60 \times 1/5 \times 10{,}201 = 1{,}224$ British thermal units, and the efficiency of the boilers is reduced to fifty-eight per cent in consequence of this incomplete combustion of a portion of the fuel.

This additional loss is a considerable amount, nine per cent, of the total heat energy of the fuel, and the calculation shows the necessity for keeping a close check upon the presence of CO in the exit-gases.

Since the automatic recording instruments now in general use for checking the composition of the exit-gases from steam boiler plants do not record the presence of CO, it is evident that independent tests with an Orsat apparatus ought at times to be made, in order to check the presence or absence of CO. This gas is most likely to be present when attempts are being made to work with a minimum of air and thick fires, in order to attain a high percentage of CO_2 in the exit-gases. Thus, efforts to reduce the heat losses due to excess of air, unless under a chemist's control, may result in very considerable heat losses in another direction. The need for expert scientific control of the testing work is therefore apparent, and automatic testing apparatus, though useful, is not an efficient substitute for the trained chemist.

The subject of gas-testing will be dealt with at length in Articles IX to XII of this series; but it may be pointed out here that, as fuel and gas analysis enables one with ease and a fair degree of accuracy to determine the thermal efficiency of the whole boiler installation, it is deserving of more attention than has yet been accorded to it by engineers in charge of boiler plants. In fact, these test results enable one at a moderate expense to achieve daily or weekly what at present is only carried out at long intervals of time and with much disturbance to the usual routine, under conditions of working which can not be regarded as normal. The money now expended upon special steam-raising and efficiency trials, if expended in the way suggested upon regular testing work would lead, in the author's opinion, to far more valuable results, and to a far better average of efficiency, than is attained under the present system. No doubt, in time, the value of fuel and gas analysis in controlling the work of boiler installations will be fully recognized. This work must be carried out, however, under expert control, for the results obtained from it to be of real value.

Congestion in the Patent Office.

In a recent issue of the New York *Commercial,* Fred W. Barnaclo called attention to the serious situation confronting the patent office at Washington. On the first of this year the patent office had 17,353 applications waiting for action. The *Official Gazette* for September 25 shows that this number has now increased to 23,468. The number of applications received weekly varies from 800 to 1,200, and the average weekly excess over the number issued during the past nine months has been 170.

The difficulty lies in the fact that the force of examiners allowed the patent office is not large enough to handle the great number of applications now coming in; consequently, the office is getting further and further behind in its work. At the present time some departments are back from six months to a year—that is to say, this time must elapse after application is made before the applicant receives notice that his case is under attention.

The only remedy which can be suggested is that Congress grant the commissioner of patents authority to enlarge his force of examiners, so that it may handle the work as it comes in; and some arrangement should be made to enable the patent office to clear up the work now awaiting action. The additional expense of this, it is suggested, might be charged against the $7,000,000 surplus now credited to the patent office in the treasury.

The long delay now occurring in securing patents is a hardship not only to the patentee, but to others interested in his methods or device. Definite business arrangements can not be made satisfactorily on a mere application, and a delay of six months to a year in securing a patent generally means a similar delay in placing the device upon the market. Thus, not only does the inventor suffer, but also those who would profit from his ingenuity. The matter will probably be brought formally to the attention of Congress, and efforts made to secure relief.

The Railway Signal Association.

The annual meeting of the Railway Signal Association will be held at the New Willard Hotel, Washington, D. C., October 16, 17 and 18. Sessions will be held on Tuesday from 10 A. M. to 1 P. M., and from 2 P. M. to 5 P. M.; on Wednesday from 10 A. M. to 1 P. M., and from 2 P. M. to 5 P. M.; on Thursday from 9.30 A. M. until adjournment.

On Tuesday committee No. 8 will make a report on "Standard Specifications for All Electric Interlocking and Material for Construction Work," together with recommendations. There will be a special committee report on "Standard Specifications for Mechanical Interlocking and Material for Construction Work." Committee No. 4 will make a report on "Installation, Maintenance, Etc., of Storage Batteries," and a special committee will report on "How to Remedy Effects of Foreign Currents on Automatic Block Signals," together with recommendations. There will also be presented an amendment to the constitution.

On Wednesday committee No. 12 will report and make recommendations on "Specifications for Rubber-Covered Wire." Committee No. 11 will report on "Oil to Be Used in Signal Lamps," as well as "Design of Lamps." There will be a special committee report on "Interlocking and Block Signals," which will cover recommendations for the various positions and indications which can be derived from the signal operating in the upper quadrant, as recommended by the association at its last annual meeting. Committee No. 1 will recommend specifications for relays, and committee No. 6 will present a progress report on "What Shall Constitute Cost in Estimates for Installation and Record of Maintenance?" Committee No. 3 will make a report on "Circuits for Interlocked Signals," together with history and recommendations.

The following papers will also be presented: "Devices to Keep Railroad Switches from Becoming Clogged with Snow and Ice," by F. Shaw, and "The Optics of Signal Lenses," by William Churchill.

An extensive programme of entertainment has been provided, and a special feature of the meeting will be the reception by President Roosevelt of the entire association at the executive mansion at 2.30 P. M., October 18.

Meeting of the American Institute of Electrical Engineers.

The two hundred and ninth meeting of the American Institute of Electrical Engineers was held at the Edison Auditorium, 44 West Twenty-seventh street, New York city, on the evening of Friday, September 28. As this meeting opened the season of 1906-1907, Dr. Samuel Sheldon, the new president, delivered his inaugural address. Dr. Sheldon pointed out the work of the secretary's office and enumerated in considerable detail the manifold duties which the secretary has imposed upon him. Each of the various committees entrusted with the work of the Institute was mentioned and its duties commented upon. Dr. Sheldon made a plea for the maintenance of a high standard of requirement for transfer to the grade of member. The board of examiners receives the applications of all associates who desire transfer, and its work is very much increased because of the loose and indefinite manner of filling out the specification papers on the part of the applicant. The tendency is to refer to members of professional eminence or to those prominent in Institute work, rather than to members who are familiar with the applicant's career and who are competent to corroborate the statements made in his application.

The removal of the executive offices to the new Engineering Building will entail an increased expenditure for carrying on the Institute work. To provide for this the simplest means seems to be to increase the membership. The secretary's staff is able, with slight additional expense, to take care of twice as many members as are now enrolled. The committee on increase of membership will take active measures to bring to the attention of non-members the advantages to be obtained from membership in the organization.

The committees on telephony, local organizations, high-tension transmission and the library committee will all be continued, and the committee on bibliography will have in press probably by next December a chronologically arranged, annotated bibliography of the Wheeler gift. Dr. Sheldon pointed out the labor which is imposed upon the editing committee, and suggested that this responsibility should be delegated entirely to the editor, and the labor performed in the secretary's office.

Professor F. B. Crocker and C. O. Mailloux, on the committee of standardization, represented the Institute at a meeting held recently in England, at which ten nations were represented. An organization of an International Electrotechnical Commission was effected, in which the Institute, as representing the United States, will be entitled to one vote. This commission will probably meet during the coming year. The committee on standardization also has in hand the rearrangement and reclassification of a report which was presented in a preliminary form at the last convention of the Institute.

The committees on National Electric Code, law, papers and finance will be continued, and their work made of greater value, if possible, to the Institute.

As a result of the efforts of the building fund committee, $132,000 has been raised. Of this $94,000 has been paid, and $38,000 is in the form of time pledges. It is hoped and expected that when the new building is formally given over to the united engineering societies during the coming year that the full amount of $180,000 due from the Institute will have been raised. The architect quite recently stated that the building would be ready for occupancy on December 1, 1906.

The first paper of the evening was entitled "The Effect of Iron in Distorting Alternating-Current Wave-Form," by Frederick Bedell and Elbert T. Tuttle. In abstracting this paper, Professor Bedell recited some of the history of the introduction and use of alternating currents, and made frequent reference to blackboard diagrams in elucidating his argument. The essential points brought out in the paper are enumerated in the first two paragraphs, as follows:

"It is well known that in a circuit containing no iron an impressed sinusoidal electromotive force will cause a sinusoidal current to flow, the current lagging behind the impressed electromotive force by an amount depending upon the relative values of the resistance and inductance, which in this case is constant. Assuming inductance alone in the circuit, the sine current which flows lags ninety degrees behind the sine electromotive force, and represents no power, the power-factor (cos 90°) being zero.

"It is also well known that if the conductors of the circuit encircle iron the inductance will no longer be constant. The current resulting from an impressed sinusoidal electromotive force will no longer be sinusoidal, but will be distorted and consist of a first harmonic or fundamental sine current of the same frequency as the electromotive force and harmonics of three, five, seven, etc., times the fundamental frequency."

The purpose of the authors in this paper was to study more fully the relation between the harmonics introduced by iron into the current wave and the hysteresis loop of the iron to which these harmonics are due.

It can be shown that certain harmonics, defined by their amplitude and phase with reference to the fundamental, can be produced by iron; others can not, these latter being excluded as impossible by the determination of some physical limitation. Professor Bedell showed that by changing the phase angle of the harmonic the hysteresis loop would be changed, fattening up to a maximum, then collapsing to a straight line, and expanding again in the opposite direction to a negative maximum.

In attempting to discover a relation between the area of hysteresis loop and the angle of hysteretic advance, a geometrical presentation was given. A vector representation in three dimensions was made use of. The conclusion reached is that an alternating current is distorted when iron is present by the introduction of a third harmonic in advance of the fundamental by an angle, θ, which is greater than thirty degrees, and less than 180 degrees. Taking the fundamental as unity, this harmonic can not exceed a definite value of about 0.192 for $\theta = 30°$ and 0.333 for $\theta = 180°$. The angle, ψ, of hysteretic advance due to the third harmonic can not exceed thirty degrees. From the shape of the hysteresis loop obtained from the third harmonic only it is concluded that iron introduces higher harmonics in addition to the third.

In opening the discussion on this paper Dr. Charles P. Steinmetz said that at first glance the paper presented by Professor Bedell, while an excellent theoretical proposition, appeared to have but little practical value to the engineer. The fact remains, however, that pure science and applied engineering are coming closer and closer together, and he would attempt to show that the theoretical treatment presented in the paper of the evening was of great importance in electrical engineering. Dr. Steinmetz then proceeded to elucidate the characteristics of the effect of wave distortion in alternating-current circuits. He suggested that the change of character in the complex current wave form was due to the change of phase, but that where this wave reached a hump and then decreased it should not be considered that

this was the end of the study. Further research, taking into consideration harmonics higher than the triple harmonic, would show that this complex wave is capable of being altered—built up, as it were—so as to carry out the expected phenomena of an increasing current so long as there was an increasing magnetization. Dr. Steinmetz also showed the relations which the distortion would have to a three-phase transmission system, particularly where there might be three transformers grouped either in star or delta. As each of the currents in the circuit would be 120 degrees apart, the current resulting from the triple harmonic would be three times 120 degrees, or 360 degrees apart; and, under certain conditions, this might reach values of no mean order. In fact, dangerous potential surges and short-circuit currents of considerable volume might be present. This reasoning applied, as well, to three-phase generators.

Dr. William S. Franklin followed Dr. Steinmetz in discussing this paper. His remarks, however, were devoted chiefly to calling attention to the fact that engineers and physicists should be very careful to make use of a nomenclature which would bring to mind a picture so closely related to the subject under discussion that there could be no confusion in the mind of any one. In speaking of an harmonic motion what one had in mind was the motion of a swinging pendulum. This was a true sinusoidal motion, and when the expression, "sinusoidal," was used, the definition should be sharply drawn to mean a pure harmonic motion. Again, in making use of vector representations he could hardly favor the use of a third dimension. While he was highly impressed with the utility of vector representations, these should be used only to show the continuous progress of electrical characteristics in the electrical or magnetic circuit. At no time should the vector diagram be used to give a geometrical picture of results. The one great fault which seems to have become common among engineers and teachers is the utilization of ideas, which, while of considerable theoretical value, can not be considered practical. In making use of theoretical considerations it is his belief that but very little consideration should be given to formulæ which would not be applicable to the common measuring instruments in use. Again, he urged that engineers and physicists stop wasting time looking for a mathematical formula which could be applied to the hysteretic loop. He believes that there is no law of nature which will fit this case, and there is no use spending time trying to get something which approximates to it.

Professor Bedell, replying briefly, thanked Dr. Steinmetz for his very able discussion of the subject, and voiced his entire agreement with Dr. Franklin's ideas with regard to trying to apply rational formulæ to irrational conditions.

The second paper of the evening, entitled "The Current Transformer," by Kenneth L. Curtis, was abstracted by Dr. W. S. McAllister, who pointed out the principal points enunciated by the author. Mr. Curtis stated that a current transformer, although mentioned but briefly in electrical literature, is one of the most indispensable of meter auxiliaries. By means of it currents of any magnitude may be measured with accuracy when employing the smallest of instruments. It enables us to use ammeters and wattmeters in circuits of the highest voltages. By the use of current transformers of different ratios we can use meters of the same size and capacity in circuits of widely varying power and voltage, thereby facilitating the calibration and maintenance of the instruments. The paper shows that the factor which prevents a constant ratio of secondary to primary current for all loads is the exciting ampere-turns. The smaller these are in proportion to the total ampere-turns of the transformer, and the lower the power-factor of the exciting current, the more nearly will we approach a constant ratio. Assuming the secondary to have as low resistance and inductance as is practicable, to obtain the best results we must make the magnetic circuit so as to have as low values of reluctance, hysteresis and eddy currents as possible—that is to say, if the secondary has as low resistance and reactance as is practicable, the best current transformer will be the one containing the most iron of the best quality in the form of the thinnest laminations.

Following the reading of this paper, owing to the lateness of the hour, L. T. Robinson briefly described a new instrument which he has been experimenting with. He presented a number of curves and results of tests, which showed that over considerable ranges a difference of less than one-half of one per cent was possible, and over wider ranges the differences were always less than one per cent.

The secretary announced that at the meeting of the board of directors, held during the afternoon, 191 associates were received. There was one transfer to the grade of full membership—George Augustus Wells, Jr., New York city.

The meeting was then adjourned.

The Boston Rejuvenation of the Sons of Jove.

Rejuvenation No. 18 of the Sons of Jove was held at the Revere House, Boston, Mass., on September 20, under the auspices of T. H. Bibber, Jovian statesman. The following officers presided: Jupiter, J. H. Waterman; Pluto, Frank Booth; Neptune, W. L. Adams; Vulcan, Charles B. Burleigh; Mars, W. S. Sisson; Apollo, W. F. Hessel; Mercury, C. B. Roulet; Hercules, Oscar Hoppe; Imps, N. H. Henderson, Albert Mann and S. B. Condit.

The ceremonies were opened promptly at 7.30 P. M., and thirty-one candidates were initiated into the order. Immediately succeeding the initiation the doors to the banquet hall were thrown open and forty-one Jovians took part in the banquet and other entertainment. Music was furnished by Charles F. White, and C. B. Burleigh acted as toastmaster. Responses were made by a number of those present.

A committee of three, consisting of Messrs. Booth, Condit and Hessel, was appointed to form a Jovian lunch club, with the idea of having the brother Jovians meet daily at lunch, the place to be designated later.

It was voted that the success of the rejuvenation was due in a great measure to the earnest efforts of T. H. Bibber, and Mr. Bibber was tendered a standing toast.

Not a little of the success of this meeting was also due to the personal attention given by C. B. Roulet, of Dallas, Tex., and also by Frank Booth, who was warmly congratulated for his work.

Organization of the Home Telephone Company of Detroit.

The following officers and directors have been elected in organizing the Home Telephone Company, of Detroit, Mich.; president, Clarence M. Burton, Detroit; first vice-president, Max Koehler, St. Louis, Mo.; second vice-president, C. Marquard Forster, St. Louis, Mo.; secretary-treasurer, W. B. Woodbury, Detroit; assistant secretary, C. H. Hood, Detroit.

Directors—Henry Koehler, Jr., and A. W. Lambert, St. Louis; C. M. Burton, Detroit; W. W. Hannan, Samuel B. Jeffries, St. Louis; T. A. E. Weadock, Detroit; C. M. Forster, St. Louis; W. B. Woodbury, Detroit; A. N. Edwards, St. Louis; Elias Michael, St. Louis.

Executive committee—C. M. Burton, chairman; W. B. Woodbury, secretary; Max Koehler, A. W. Lambert.

THE EFFECT OF IRON IN DISTORTING ALTERNATING-CURRENT WAVE-FORM.[1]

BY FREDERICK BEDELL AND ELBERT B. TUTTLE.

INTRODUCTION.

It is well known that in a circuit containing no iron an impressed sinusoidal electromotive force will cause a sinusoidal current to flow, the current lagging behind the impressed electromotive force

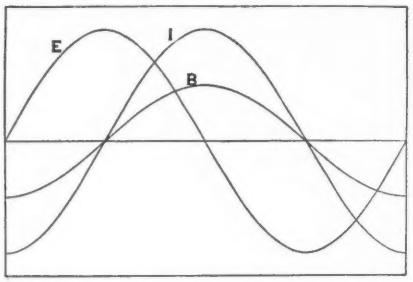


FIG. 1.—SINUSOIDAL CURRENT I AND INDUCTION B, LAGGING 90° BEHIND THE SINUSOIDAL ELECTROMOTIVE FORCE E WHEN NO IRON IS PRESENT.

by an amount depending upon the relative values of the resistance and inductance, which in this case is constant. Assuming inductance alone in the circuit, the sine current which flows lags 90° behind the sine electromotive force and represents no power, the power-factor (cos 90°) being zero.

It is also well known that if the conductors of the circuit encircle iron, the

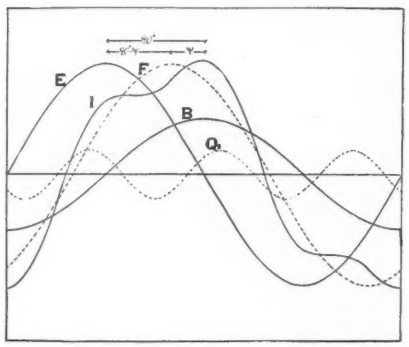


FIG. 2.—COMPLEX CURRENT I AND INDUCTION B, WITH MAXIMUM VALUES 90° BEHIND SINUSOIDAL ELECTROMOTIVE FORCE WHEN IRON IS PRESENT. THE FUNDAMENTAL (F) LINE CURVE OF CURRENT LAGS (90° — ψ) DEGREES BEHIND E.

inductance will no longer be constant. The current resulting from an impressed sinusoidal electromotive force will no longer be sinusoidal, but will be distorted and consist of a first harmonic or fundamental sine current of the same frequency as the electromotive force, and harmonics of 3, 5, 7, etc., times the fundamental frequency.

[1] A paper presented at the two hundred and ninth meeting of the American Institute of Electrical Engineers, New York, September 28, 1906.

One of the first studies of this subject was made by Ryan and Merritt[1] who, from experimental curves of current and electromotive force, determined the hysteresis loop for the iron of a transformer. Steinmetz[2] taking certain hysteresis loops and assuming a sinusoidal electromotive force, has determined the complex current wave for a large number of cases.

The purpose of the present writers is to study more fully the relation between the harmonics introduced by iron into the current wave, and the hysteresis loop of the iron to which these harmonics are due. For example, it can be shown that certain harmonics, defined by their amplitude and phase with reference to the fundamental, can be produced by iron; others can not, these latter being excluded as impossible by the determination of some physical limitation. The condition that hysteresis in iron causes it to absorb rather than to give out energy, at once renders certain harmonics impossible. The fact that the

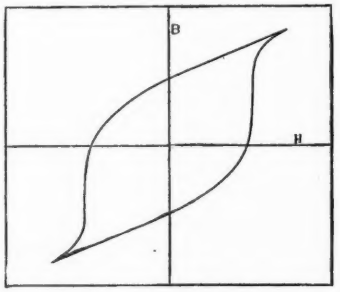


FIG. 3.—HYSTERESIS LOOP CORRESPONDING TO FIG. 2.

current can have a maximum value only coincident with the maximum value of induction in the iron is likewise a limitation. Again, the fact that after saturation the permeability decreases with the increase of the induction is a further limitation.

[1] Transactions, A.I.E.E., vol. vii, p. 1.
[2] Steinmetz, "Alternating-Current Phenomena," chap. x.

In case of a sine electromotive force and a complex current wave due to iron, the harmonics in the current wave (being 3, 5, 7, etc., times the frequency of the electromotive force) can represent no power.[1] Any power must accordingly come from that part of the complex current wave which is of the same frequency as the electromotive force. If this current lagged 90° behind the electromotive force, as it does with no iron present, there would be no power, as has already been pointed out. But the current of fundamental frequency is shifted ahead by an angle, ψ, of hysteretic advance due to the iron, so that it lags less than 90° behind

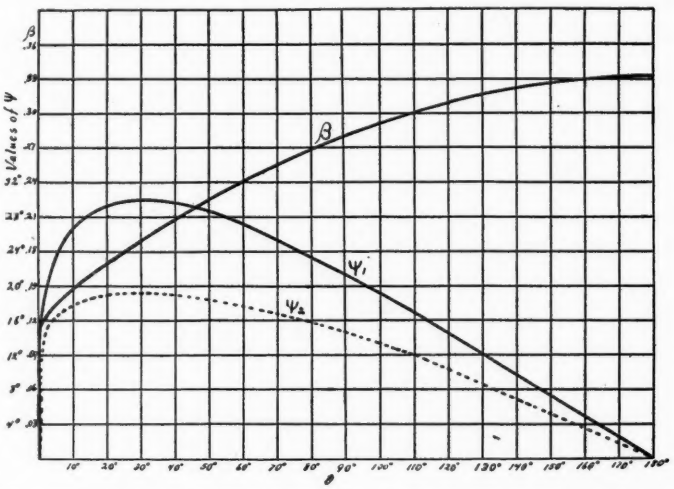


FIG. 4.—LIMITING VALUES OF B (AMPLITUDE OF THE THIRD HARMONIC) AND ψ (HYSTERETIC ADVANCE) FOR VARIOUS PHASE POSITIONS OF THIRD HARMONIC.

the electromotive force; consequently it represents power, this being the power expended in hysteresis.

The current of fundamental frequency which we are to consider might be taken either as the fundamental sine curve, as we analyze the current into components of 1, 3, 5 times the frequency; or, as the equivalent sine curve, which is a sine curve equivalent in its effect to the fundamental and higher harmonics combined. The distinction between the fundamental and equivalent sine curves, which have sometimes been confused, will be taken up more fully later.

A relation will be sought between the

[1] A symmetrical hysteresis loop introduces odd harmonics only. Taking $e = E \sin \omega t$ and current i, the work done per cycle is

$$W = \int_0^{2\pi} e\, i\, d\, t.$$

For any odd harmonic of n times the frequency, $i_n = I_n \sin n \omega t$. With this value substituted for i, the integral vanishes and $W = 0$.

hysteresis loop for any iron and its angle of hysteretic advance.

Finally, consideration will be given to the effect of hysteresis upon the vector representation of alternating currents, and it will be shown that the complete diagram in any problem can no longer be drawn in a plane.

EFFECT OF THIRD HARMONIC.

From Faraday's law,

$$e = -\frac{d\phi}{dt} = -A\frac{dB}{dt},$$

it follows that if the electromotive force[1] impressed upon a coil be sinusoidal, the magnetic flux threading the coil will likewise be sinusoidal, and in phase 90° behind the electromotive force. This is true whether the coil embraces iron or not.

If the coil does not embrace iron, the current likewise is sinusoidal and 90° behind the electromotive force; the flux is in phase with the current, and proportional to it (Fig. 1). We may then write

$$e = -A\frac{dB}{dt} = -L\frac{di}{dt}.$$

The inductance L is constant; and hence the induction B is proportional to current i and magnetizing force H, permeability being constant. The hysteresis "loop," plotted between B and H, becomes then a straight line.

With iron present, inductance and permeability are not constant. The induction B is no longer proportional to the current i and magnetizing force H, and with induction B sinusoidal (due to sine impressed electromotive force), the current i is not sinusoidal, but distorted as in Fig. 2. Since B and H are no longer proportional, instead of a straight line we have the hysteresis loop representing their cyclic variation.

In the following work we shall deal with the fundamental and third harmonic only. The process will be to assume successively definite relative amplitudes and phase positions for these and build up the complex current wave. From this complex wave of current and the sine wave of flux, the hysteresis loop which would cause such a current is determined.

The equation for the current is

$$i = \sin\omega t + \beta\sin(3\omega t + \theta).$$

The amplitude of the third harmonic is β (taking the fundamental as unity) and θ is its phase-angle, $+\theta$ indicating an advance, and $-\theta$ a lagging of the origin of the harmonic relatively to the origin of the fundamental.

Let us take a typical case represented in Fig. 2. The assumed fundamental and third harmonic of the current are represented by dotted curves. Here the amplitude of the harmonic is taken to be

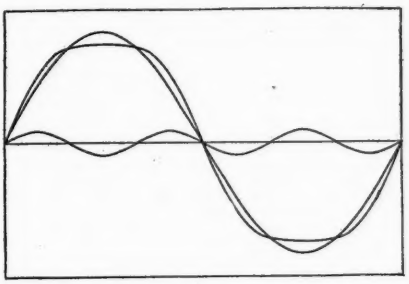


FIG. 5.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 0$. SEE TABLE II FOR DATA FOR ALL CURVES.

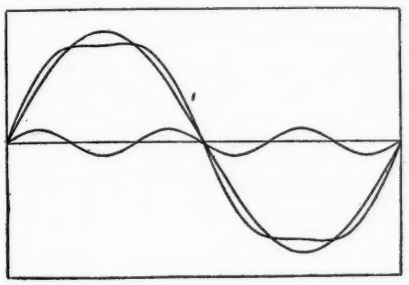


FIG. 6.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 2°$

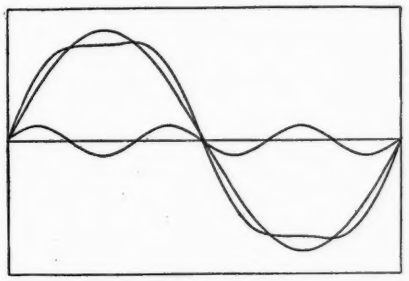


FIG. 7.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 5°$

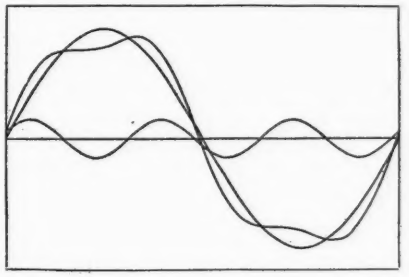


FIG. 8.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 20°$

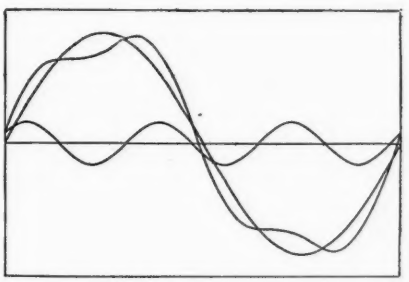


FIG. 9.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 30°$

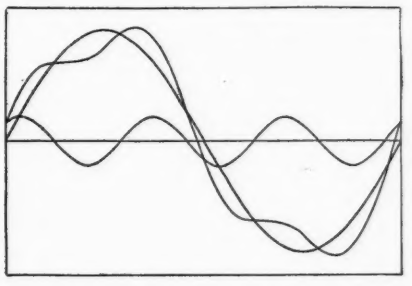


FIG. 10.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 45°$

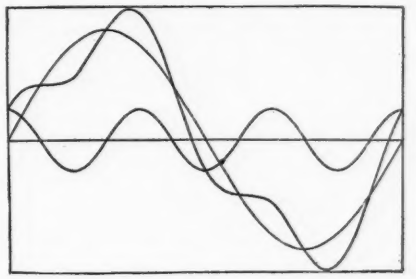


FIG. 11.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 90°$

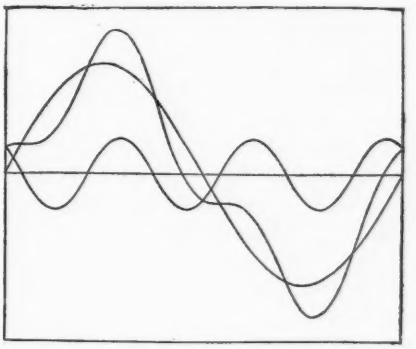


FIG. 12.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 135°$

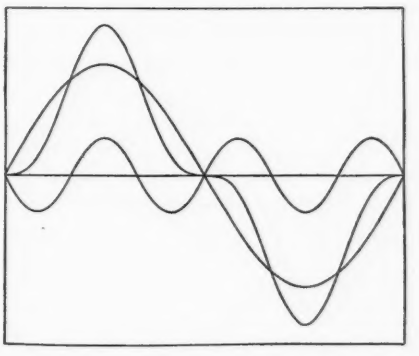


FIG. 13.—COMPLEX CURRENT CURVE, FUNDAMENTAL AND THIRD HARMONIC FOR $\theta = 180°$

[1] Not including ohmic electromotive force.

$\beta = 0.22$ (the amplitude of the fundamental being unity) and θ is taken to be $+ 45°$. The maximum of the current wave necessarily coincides in time with the maximum of the induction (for in a hysteresis loop the maximum H coincides with the maximum B). The sinusoidal

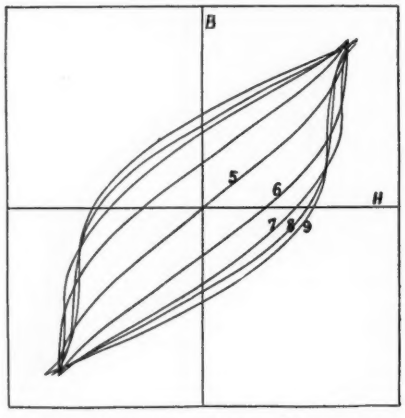


FIG. 14.—HYSTERESIS LOOPS CORRESPONDING TO FIGS. 5 TO 9. $\theta = 30°$ OR LESS.

flux, in accordance with Faraday's law, is 90° behind the sinusoidal electromotive force; accordingly, the maximum of the induction, and hence of the current, is 90° behind the electromotive force. It will be noted, however, that the fundamental of the current wave has its maximum in advance of the maximum of the complex wave by an angle ψ, the hysteretic angle of advance, in this case equal to 29° 23′. The fundamental current wave lags then $90° - \psi$ behind the electromotive force and represents power consumed by hysteresis, with a power-factor $\cos (90° - \psi) = \sin \psi$.

If θ, the phase-angle of the harmonic, is between 0° and 180°, we find that the right-hand side of the complex current

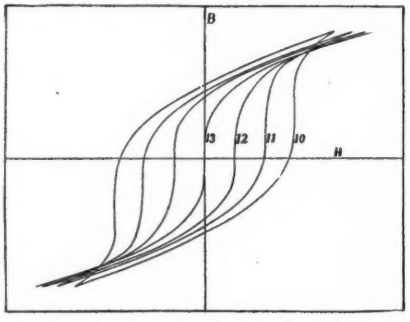


FIG. 15.—HYSTERESIS LOOPS CORRESPONDING TO FIGS. 10 TO 13. θ GREATER THAN 30°

wave will have a hump, as in Fig. 2. The fundamental will be advanced to the left so as to lag less than 90° behind the electromotive force, representing power taken by hysteresis—a possible case.

If, however, θ is between 180° and 360°; that is, if the harmonic is made to be behind instead of in advance of the fundamental, the hump on the current curve will be found on the left, and the fundamental will be shifted to the right so as to lag more than 90° behind the electromotive force, representing power given out by hysteresis—an impossible case. In this case the hysteresis loop would needs be traversed in the reverse direction from the actual counter-clockwise direction and its area would represent work given out per cycle. Fig. 2 turned upside down would represent such a case.

DERIVATION OF HYSTERESIS LOOP.

A hysteresis loop consists in plotting corresponding values of B and H in rectangular coordinates. A hysteresis loop corresponding to the curves of Fig. 2 is correspondingly readily plotted. H is directly proportional to I, and hence the curve for I may be taken as a curve for H. Corresponding values of H and B are taken directly from the curves in Fig.

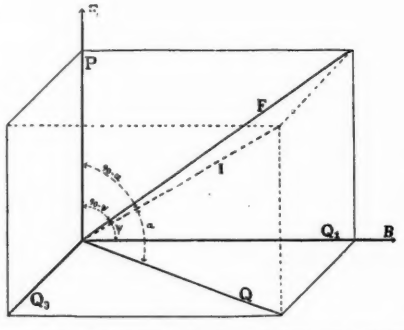


FIG. 16.—VECTOR REPRESENTATION IN THREE DIMENSIONS OF A COMPLEX CURRENT. E IS SINE ELECTROMOTIVE FORCE; F IS FUNDAMENTAL CURRENT; Q_3 REPRESENTS HARMONICS; AND I IS THE EQUIVALENT SINE CURRENT.

2 and plotted in rectangular coordinates to give the hysteresis loop of Fig. 3.

The interpretation is this: we arbitrarily assume a complex current I, made up of a fundamental and third harmonic, Fig. 2. The sinusoidal induction B and electromotive force will then be as shown in Fig. 2. The hysteresis loop which would produce the assumed distortion is shown in Fig. 3.

When $\theta = 0°$, or 180°, the hysteresis loop becomes a curved line; the ascending and descending curves coincide and enclose no area, representing therefore no hysteresis loss, although the permeability varies. These cases are shown by curves 5 and 13 in Figs. 14 and 15. They are impossible limiting cases; the angle θ must accordingly be more than 0° and less than 180°, and positive.

It will be shown later that θ must be greater than 30°, and that all the curves in Fig. 14 (corresponding to values of θ from 0° to 30°) are impossible.

The hysteresis loops derived in this paper from consideration of the fundamental and third harmonic only in the current wave, have an unnatural appearance, particularly near the maximum values. Hence it is concluded that the fifth and other higher harmonics are

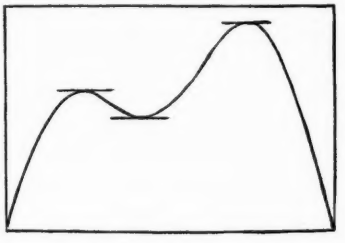


FIG. 17.—TWO CRESTS, ONE TROUGH AND TWO INFLEXIONS.

necessary in the complex wave in order to derive therefrom a more normal hysteresis loop, particularly when saturation in the iron is passed.

LIMITING VALUES OF AMPLITUDE OF HARMONIC, AND OF HYSTERETIC ADVANCE.

It will be found that for $\theta = 0°$ the amplitude β of the harmonic can not be greater than $\frac{1}{9}$; and for $\theta = 180°$, the value of β can not be more than $\frac{1}{3}$, the fundamental being taken as unity. The limiting possible values of β for various values of θ are shown in Fig. 4 and are given in Table I. If β exceeded

TABLE I.

LIMITING VALUES OF β AND ψ FOR VARIOUS VALUES OF θ.

θ	β	ψ
0°	0.111	0°
	0.112	5° 41′
	0.113	7° 59′
	0.116	11° 8′
1° 17′	0.120	16° 20′
1° 45′	0.122	16° 54′
4° 48′	0.133	22° 30′
6° 55′	0.140	24° 28′
8° 34′	0.144	25° 35′
12° 52′	0.156	27° 40′
14° 15′	0.160	28° 15′
17° 37′	0.167	28° 57′
22° 44′	0.178	29° 41′
23° 47′	0.180	29° 47′
30° 39′	0.192	30° 00′
33° 59′	0.200	29° 56′
40° 6′	0.211	29° 34′
45° 14′	0.220	29° 6′
46° 34′	0.222	27° 43′
57° 44′	0.240	27° 28′
60° 42′	0.244	27° 1′
71° 44′	0.260	25° 8′
76° 48′	0.267	24° 9′
87° 47′	0.280	21° 56′
95° 54′	0.289	20° 12′
107° 16′	0.300	18° 4′
120° 40′	0.311	14° 34′
134° 4′	0.320	11° 22′
143° 35′	0.322	10° 23′
157° 18′	0.330	5° 43′
180°	0.333	0°

the limiting value, the resultant current would have two maxima in a half cycle, as in Fig. 17 of the Appendix. This is

impossible, as it would mean corresponding maxima in the values of H. This would cause H to have four maxima per cycle, as in Fig. 18, while B has but two.

Curve ψ_1, in Fig. 4, shows the greatest possible values of the angle of hysteretic advance for various values of θ; this curve corresponding to limiting values of β given in curve β. Other values of β

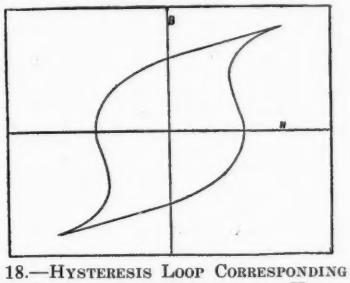


FIG. 18.—HYSTERESIS LOOP CORRESPONDING TO FIG. 17, WITH FOUR MAXIMA FOR H WHICH WOULD RESULT WERE THE LIMITS OF β GIVEN IN FIG. 4 EXCEEDED.

will give a smaller value for ψ as shown in curve ψ_2 which shows ψ for $\beta = \frac{1}{3}$ for all values of θ. It is seen that in no case can ψ be greater than 30°.

For the method of determining the limiting value of β, and also for ψ, as given in the table and shown in Fig. 4, a full discussion of which is given in the appendix, we are indebted to Professor James McMahon.

A year ago M. C. Carpenter, at the suggestion of one of us, plotted a large number of complex curves and hysteresis loops for different values of θ and β, with a view to determining their limiting values by a method of cut and trial; but it proved impossible in this way to get definite results.

DISCUSSION OF CURVES.

The curves in Figs. 5-13 show the complex current wave resulting from a fundamental and third harmonic in various phase positions from 0° to 180°, the amplitude of the harmonic being in all cases the greatest possible according to values for β shown in Fig. 4. The data referring to these curves are given in Table II.

TABLE II.

The amount of shifting to the left of the fundamental (the hysteretic advance), is readily observed in each case, this being ψ. The hysteretic angle ψ increases with hysteresis loss, the power-factor for hysteresis being cos ψ. In Figs. 5 and 13, for $\theta = 0°$ and 180° ψ is 0 and the maxima of the fundamental and complex waves are coincident; hence power consumed by hysteresis is zero.

The corresponding hysteresis loops for all cases are shown in Figs. 14 and 15. Loops 5 and 13, for $\theta = 0°$ and $\theta = 180°$, have no area, which likewise indicates that the power consumed by the hysteresis is zero.

Curves shown in Figs. 5 to 9 are for various values of θ equal to or less than 30°, the corresponding hysteresis loops being shown in Fig. 14. The upward turn of these loops, when θ is less than 30°, shows these cases to be impossible; for they would indicate an increase instead of decrease in the permeability for increasing values of induction beyond saturation. Possible values of θ must accordingly be between 30° and 180.°

(To be concluded.)

National Electric Light Association.

At a recent meeting of the executive committee of the National Electric Light Association the matter of offices in the United Engineering Building was formally decided. The association will change its headquarters as soon as practicable after the new building is ready for occupancy. There was an unusually full attendance at the meeting, and several important measures were set in motion.

TABLE II.

DATA RELATIVE TO CURVES IN FIGS. 5-13.

Curve No.	θ	β	α	ψ	I	I′
5	0°	0.111	0°	0°	1.006	0.8890
6	2°	0.122	16° 54′	17°	1.007	0.8832
7	5°	0.135	22° 48′	23°	1.009	0.8833
8	20°	0.172	29°	29° 30′	1.015	0.9250
9	30°	0.193	29° 33′	30°	1.019	0.9624
10	45°	0.220	28° 38′	29° 22′	1.024	0.9868
11	90°	0.283	19° 36′	20° 30′	1.039	1.1850
12	135°	0.321	10° 12′	10° 45′	1.050	1.2950
13	180°	0.333	0°	0°	1.053	1.3330

θ is the phase relation of the third harmonic to the fundamental at the origin.

β is the ratio of the maximum ordinates of the fundamental and third harmonic (critical value).

ψ is the phase difference between the maxima of the distorted and fundamental curves.

$90 - \psi$ is lag of fundamental component of current behind electromotive force.

$90 - \alpha$ is lag of equivalent sine current behind electromotive force.

I and I′ are the maxima of the equivalent sine curve and distorted curve, respectively, the maximum value of the fundamental being unity.

Among the new applications for membership passed upon and approved were the following:

CLASS A.

North Georgia Electric Company, Gainesville, Ga.

Millville Electric Light Company, Millville, N. J.

McCall Ferry Power Company, New York, N. Y.

The Miami Light, Heat and Power Company, Piqua, Ohio.

Laramie Light and Power Company, Laramie, Wyo.

Albany Power and Manufacturing Company, Albany, Ga.

Toledo Gas, Electric and Heating Company, Toledo, Ohio.

Escambia County Electric Light and Power Company, Pensacola, Fla.

CLASS B.

E. J. Fowler, Chicago Edison Company, Chicago, Ill.

J. W. Murray, Allegheny County Light Company, Pittsburg, Pa.

A. S. Allen, Tonawanda Power Company, Tonawanda, N. Y.

G. H. Patten, Chattanooga Electric Company, Chattanooga, Tenn.

Arthur L. Linn, Rochester Railway and Light Company, Rochester, N. Y.

E. A. Phinney, Ouray Electric Power and Light Company, Ouray, Ohio.

Henry Stephenson, New York Edison Company, New York, N. Y.

J. W. Young, McCall Ferry Power Company, New York, N. Y.

H. M. Edwards, New York Edison Company, New York, N. Y.

Charles S. Shepard, New York Edison Company, New York, N. Y.

William S. Dupont, Public Service Corporation of New Jersey, Newark, N. J.

James T. Whittlesey, Public Service Corporation of New Jersey, Montclair, N. J.

J. Kennedy, Public Service Corporation of New Jersey, Weehawken Heights, N. J.

Edward J. O'Beirne, Gainesville Electric Railway and Light Company, Gainesville, Tex.

CLASS D.

Michaelis & Ellsworth, New York, N. Y.

Roderick J. Parke, Toronto, Canada.

The Lundin Electric and Machine Company, Boston, Mass.

Condit Electrical Manufacturing Company, Boston, Mass.

The Shelby Electric Company, Philadelphia, Pa.

CLASS E.

James D. Ellsworth, Michaelis & Ellsworth, New York, N. Y.

English Overhead Transmission Lines and Distribution Mains.

While the methods of installing electrical apparatus in Great Britain are carefully supervised by the Board of Trade, this body has not yet adopted any special regulations for high-tension transmission systems, and work of this character therefore conforms to the rules for ordinary voltages, though extra precautions are taken. The electrical engineer contends with a good many difficulties in England, one of these being that of obtaining the right of way. The transmission line is seldom straight, but twists and turns according to the fancy of the owners of the property across which it passes. As an example of the character of work now being done in transmission line construction the line of the Lancashire company is described. This company has a considerable length of 11,000-volt overhead conductors in service, carried on wooden poles. In erecting the wire it is drawn up so that there is a factor of safety of five at a temperature of twenty-five degrees. This includes also an allowance for wind pressure equivalent to fifty miles per hour. The average span is fifty yards, and the poles are of the A type—that is, two poles bolted together at the top, but separated slightly at the bottom. The average height is thirty-two feet, six feet of this being in the ground, and the average diameter five feet from the butt is about twelve inches. The cross-arms are of oak, five inches by four inches, and a brace eight by eight inches and six feet long is fastened to the bottom of the pole. Where a road is to be crossed, a wire netting is placed below as a protection. No line is allowed to cross a road at an angle of less than sixty degrees, and in many cases the crossing must be by means of underground cables. On straight lines strain poles are erected every half mile. For turning angles two poles are employed, carefully braced and guyed. Each conductor is attached to the strain poles by three insulating shackles. The two ends of each line are cross-connected, the connecting wire being bound to an ordinary insulator. The insulator is of the triple petticoat type, made in two parts. For taking off branches four poles are erected, braced together, and the conductors are attached in the same manner as for strain poles. The branch is taken off from a higher set of cross-arms, connection being made by vertical drops to the main wires. For changing from overhead to underground work, or the reverse, a three-headed box is employed, into which the cable is brought through a lower opening. It is spread out and attached to the three overhead conductors, and the box is then filled with an insulating compound. The three heads are protected by special porcelain insulators and caps, and a copper hood soldered to the conductor. The conductors themselves are about thirty inches apart. The entire construction is very solid and has been so satisfactory that it will probably be employed for still higher voltages.—*Electrical Engineer (London), September* 14.

Standard Symbols for Wiring Plans.

At the July meeting of the National Electrical Contractors' Association a set of standard symbols for wiring plans was adopted and recommended. This set of symbols was devised after

Ceiling Outlet, Electric only. Numeral in center indicates number or standard 16 C. P. Incandescent Lamps
Ceiling Outlet, Combination. ‡ indicates 4-16 C. P. Standard Incandescent Lamps and 4 Gas Burners.
Bracket Outlet, Electric only. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.
Bracket Outlet, Combination. ‡ indicates 4-16 C. P. Standard Incandescent Lamps and 4 Gas Burners.
Wall or Baseboard Receptacle Outlet. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.
Floor Outlet. Numeral in center indicates number of Standard 16 C. P. Incandescent Lamps.
Outlet for Outdoor Standard or Pedestal, Electric only. Numeral indicates number of Stand. 16 C. P. Incan. Lamps.
Outlet for Outdoor Standard or Pedestal, Combination. ‡ indicates 6-16 C. P. Stand. Incan. Lamps, 6 Gas Burners.
Drop Cord Outlet.
Gas Light Outlet, for Lamp Receptacle.
Arc Lamp Outlet.
Special Outlet, for Lighting, Heating and Power Current, as described in Specifications.
Ceiling Fan Outlet.
S S. P. Switch Outlet.
S2 D. P. Switch Outlet.
S3 3-Way Switch Outlet.
S4 4-Way Switch Outlet.
S5 Automatic Door Switch Outlet.
S6 Electrolier Switch Outlet.
Show as many Symbols as there are Switches. Or in case of a very large group of Switches, indicate number of Switches by a Roman numeral, thus; S XII, meaning 12 Single Pole Switches.
Describe Type of Switch in Specifications, that is, Flush or Surface Push Button or Snap.
Meter Outlet.
Distribution Panel.
Junction or Pull Box.
Motor Outlet; Numeral in center indicates Horse Power.
Motor Control Outlet.
Transformer.
Main or Feeder run concealed under Floor.
Main or Feeder run concealed under Floor above.
Main or Feeder run exposed.
Branch Circuit run concealed under Floor.
Branch Circuit run concealed under Floor above.
Branch Circuit run exposed.
Pole Line
Riser.
Telephone Outlet; Private Service.
Telephone Outlet; Public Service.
Bell Outlet.
Buzzer Outlet.
Push Button Outlet; Numeral indicates number of Pushes.
Annunciator; Numeral indicates number of Points.
Speaking Tube.
Watchman Clock Outlet.
Watchman Station Outlet.
Master Time Clock Outlet.
Secondary Time Clock Outlet.
Door Opener.
Special Outlet, for Signal Systems, as described in Specifications.
Battery Outlet.
Circuit for Clock, Telephone, Bell or other Service, run under Floor, concealed.
Kind of Service wanted ascertained by Symbol to which line connects.
Circuit for Clock, Telephone, Bell or other Service, run under Floor above concealed.
Kind of Service wanted ascertained by Symbol to which line connects.
NOTE.—If other than Standard 16 C. P. Incandescent Lamps are desired, Specifications should describe Capacity of Lamp to be used.

SYMBOLS ADOPTED BY THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

numerous conferences with the architectural and engineering interests of the country. The fact is appreciated that these symbols will conflict with some of those now in use. The committee under whose direction these symbols were devised considers, however, that the particular shape of the symbol is not an important factor so long as it is reasonably simple. In designing the system this point was carefully considered, and the symbols most used will be found easy of execution, those generally in use having been adopted as far as possible.

An Electrolytic Rectifier.

A United States patent was granted on September 11 to Franz Pawlowski for an electrolytic rectifier. The novelty of the rectifier lies in the use of a solid electrolyte which is conducting while cold. This material is hemisulphide of copper (CuS). To bring the substance into a suitable state it must be carefully prepared, which is done by melting a mixture of sulphur and copper, or by subjecting sheet copper to the action of sulphurous vapors without admission of air. This produces a hard crystalline hemisulphide which resists the action of the air and water and melts only at about 1,000 degrees centigrade. The sulphide is equally conductive for all directions at ordinary temperatures. The rectifier consists in placing a sheet of copper coated in this way in contact with a sheet of aluminum. The surface of the latter must be brought into intimate contact with the sulphide, for transfer of current takes place only where such contact exists. Before the rectifier is ready for use it must be formed, which is done by passing an alternating current through it so as to produce rather violent sparking. As the formation of the aluminum plate takes place, the insulating coating in this case being a sulphide, the sparking decreases and finally stops. Such a device acts as an electric valve, allowing the current to pass through only from the aluminum to the sulphide of copper, though combinations of cells may be employed for rectifying both half-waves. The action is electrolytic, the products being dusts of copper and aluminum. This, if formed in large quantities, would be prejudicial to the working of the device, but it is said that, under ordinary conditions, the formation of dust is negligible.

Boston & New York Electric Railroad Company.

Announcement is made that the Boston & New York Electric Railroad Company intends to build a high-speed electric line between Boston and New York. The road will be built first as far as Providence, and it will then be continued on to New York. The entire road will be double-tracked on a private right of way completely fenced in. It is expected that the line will be entirely without grade crossings.

The application for a charter in Massachusetts is made by the following: A. B. Leach, James G. Campbell, William O. Blaney, Elwyn G. Preston, S. W. Reynolds, Harry M. Howard, Edward C. Sherburne, J. Walter Sanborn, Daniel W. Howland, John F. Crocker, Leroy S. Brown, Charles H. Adams, H. Staples Potter, James M. W. Hall, F. A. Kennedy, Theodore N. Vail, B. P. Cheney, Frank B. Priest, Charles D. Sias, Robert J. Edwards, James Duane Livingstone, Edward F. Woods and George N. Talbot.

NOTES ON COLLOIDS.[1]

BY ALFRED LOTTERMOSER.

The essence of a solution is that the dissolved substance should be evenly distributed throughout the entire volume of the solvent. The dissolved substance exerts a pressure, in consequence of which it diffuses itself throughout the solvent in opposition to the force of gravity; consequently, the dissolved substance behaves like a gas, which also fills any space quite evenly, but the rate of diffusion of a gas is immensely greater than that of a dissolved substance. Consequently, the laws which relate to the behavior of gases, which have been chiefly discovered by the work of van't Hoff, apply equally to dissolved substances. But soluble substances are known which possess a very small, and, indeed, almost negligible, power of diffusion; and for these substances the laws relating to gases would seem to be no longer valid. Graham first studied this matter, and he called substances of the first kind "crystalloids," since on removal of the solvent they remain behind in the crystalline state; whereas he called the substances with small power of diffusion "colloids," since glue may be considered to be a typical instance of this class. Substances of this latter class remain behind in the amorphous condition after removal of the solvent, and consequently the words "colloidal" and "amorphous" are to some extent identical. Still, a sharp line of distinction can not be drawn between colloidal and crystalloid substances, seeing that multitudinous substances are on the border line.

Assuming that the laws for gases hold good, it is possible from the diffusion-capacity, or osmotic pressure, to determine the molecular weight. According to this, the molecular weight in the case of colloids would be of the order of 10^4, and even much greater than this. Supposing that the laws for gases are assumed to hold good, we must suppose that we are dealing not with single but with complex molecules. The only other alternative is to give up the idea of solution and to introduce a new conception, as Graham did —*viz.*, that of the "hydrosol," according to which the colloid is evenly distributed throughout the solvent in an extremely fine state of division. Then the question arises as to whether it is possible to see these small particles. This question may be regarded as settled, and answered in the affirmative. It is, however, impossible to see the slightest sign of any want of homogeneity in hydrosols, even under the most powerful microscope; but Tyndall's experiment provides us with another optical method. If a beam of light, ofter being concentrated by a lens, is allowed to pass into a fluid and is then observed by the eye in a direction at right angles to the direction of the light, the beam will only appear to be invisible in that case in which the fluid is homogeneous—*i. e.*, when nothing is present which is capable of diverting the rays in any way from their path. Most solutions are of this nature, and are optically "empty." In hydrosols, however, the path of the rays is at once visible in a more or less brightly illuminated streak. This shows that small particles are present which reflect or divert a part of the rays, or, in other words, rays are diverted from their path and directed into the eye, which is looking in a direction at right angles to the path of the beam. If dust is sprinkled in a fluid, it is at once noticeable in the shape of bright particles, but these particles are a million times greater than those of a hydrosol, and consequently the latter can not be recognized in this way as separate entities. But if the above experiment is repeated under the microscope, in the way that Zsigmondy and Siedentopf suggested, it is possible to see separate particles, though it is not possible to define their shape. The metal hydrosols, which are interesting to us at the moment, were examined with great care under the ultra-microscope, as the instrument constructed by Zsigmondy was called. In most cases the particles can be seen to be in a state of lively motion, and form a picture of the greatest beauty. It is possible to determine the size of the particles, which can be seen in the brightest sunlight down to linear dimensions of $5\mu\mu$ ($1\mu\mu$ = 0.000001 millimeter). And obviously it is possible to see particles which are below this limit, seeing that Nature makes no leaps; such particles are no longer visible in the ultra-microscope as separate particles but give the impression of an evenly but weakly illuminated field of vision. On the other hand, solutions are known which are not optically "empty," and show the Tyndall phenomenon; and this shows, as I have already said, that no sharp distinction can be drawn between hydrosols and true solutions. Similarly it is not possible to define hydrosols in a purely mechanical way and to limit them to oozes, or suspended particles, which can be distinguished under the microscope. It is true that these oozes of clay or ultramarine possess none of the properties of true solutions; they do not possess the property of diffusing themselves, but then it is possible gradually to increase the size of the particles of a hydrosol until we can microscopically perceive their magnitude, in which case this hydrosol has completely lost all the properties of solutions.

It can, therefore, cause no surprise when we find that hydrosols and suspensions have many properties in common. If an electric current is passed through a suspension or a hydrosol, and even if the resistance is very great, the particles will be seen to be displaced with regard to the fluid; they are electrically opposed to the solution carrying a charge, and the direction of their displacement depends in general on the chemical nature of the particles. Therefore it is natural that the direction of their migration should be influenced by the addition of various substances, and in this respect electrolytes produce a very marked effect. (According to the electrolytic dissociation theory of Arrhenius, electrolytes are understood to be substances which cause the solution to conduct by splitting up into electrically charged particles called ions—*i. e.*, the wanderers— which give up their charges at the anode and cathode.) The effect on the direction of migration of the ions is most clearly seen in the case of very dilute solutions; but it is not possible to go minutely into this aspect of the problem. In more concentrated solutions the electrolytes produce such an effect on suspensions and hydrosols that the minute particles coagulate together and form more complex structures. The most important point to be noticed is that the effect of an electrolyte is made up of those of the two classes of ions: that ion which has an opposite charge to that of the particle in suspension, or to that of the hydrosol, exerts a precipitating influence, the extent of which depends on the nature of the ion; whereas the ion which has a similar charge tends to prevent the precipitation partially or entirely.

Although, indeed, the particles move with the electric current, as has been already mentioned, yet the hydrosols, and more particularly the metals, show only a very slight power of conductivity. This is probably due to the presence of ions. A precipated gel, which has been obtained by drying or by electrolytic action, is a non-conductor, or at any rate a very poor conductor, as Barus and Schneider have found in the case of silver. This is not surprising, seeing that they consist of small disconnected particles, even although they are immensely larger than hydrosols.

[1] Appendix to an article by Dr. C. R. Böh on modern forms of electric incandescent lamps which appeared in *Elektrotechnischer Anzeiger*, abstracted from the *Electrician*, London.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Friction and Lubrication.

Some interesting and valuable experiments, conducted some years ago by B. Tower for a research committee of the Institution of Mechanical Engineers, of Great Britain, but which have not been widely published, are described here by Professor G. F. Charnock. The work was carried out with a belt-driven shaft of steel, provided with a journal four inches in diameter and six inches long. Upon the upper side of the journal was fitted a gun-metal step, the arc of contact being rather less than half the circumference. Various means of lubrication were provided, the best being a bath of oil. The results of the experiments were that the friction is nearly constant under all loads, within ordinary limits, and it does not increase in direct proportion to the load, according to the ordinary laws of friction. The coefficient of friction with bath lubrication varies inversely as the pressure; or, in other words, the friction of the bearing is altogether independent of the pressure upon it. This is provided the pressure does not exceed 400 to 600 pounds per square inch. The coefficient of friction is inversely proportional to the temperature. The friction increases with the velocity apparently nearly as the 1.5 power. The coefficient of friction varies with the lubrication used, and was found by Tower to be least for olive oil and lard oil. Sperm oil comes next, followed by mineral oil and mineral grease.—*Abstracted from the Mechanical Engineer (London), September* 1.

Oerlikon Single-Phase Locomotives.

A new locomotive equipped with single-phase commutator motors has been constructed by the Maschinenfabrik Oerlikon, of Zurich, Switzerland, for experimental trials on the Seebach-Wettingen line. The locomotive is carried on two four-wheel trucks, one motor being mounted on each truck, and geared with a ratio of one to 3.1 to an intermediate shaft, which shaft is coupled to both axles by means of a side bar. Thus, all four axles are driven. The bearing of the crank pin of the intermediate shaft is allowed a certain amount of vertical motion. The current-collecting apparatus is that recently brought out by the Oerlikon Company. It consists of a curved tubular rod of steel, on which brass rubbers are placed. These rods are mounted on a swinging frame, there being two collectors on each locomotive, enabling them to be placed in contact with the wire when it is on either side of the track or at any point over the locomotive. The locomotive is lighted by twenty-volt lamps having thick filaments, which give a fairly steady light on the low frequency of fifteen cycles. The locomotive weighs forty-three tons, of which 23.5 represent the weight of the mechanical part. Each motor weighs 3.4 tons, and is rated at 200 horse-power at 650 revolutions. It can start a train of 250 tons up a gradient of one in twelve and one-half, and attains a speed of twenty-eight miles an hour without any sparking at the brushes. It consists of a laminated field with an armature of the ordinary direct-current type. The field is provided with main salient poles as well as auxiliary poles. The exciting current for the auxiliary poles is connected through a non-inductive resistance to a series transformer. The main poles are provided with compensating windings in grooves, which may be short-circuited on themselves or placed in series with the main circuit. The motor has eight main poles, and its normal speed is about three times that of synchronism. It operates equally well at a frequency of twenty-five cycles.—*Abstracted from the Electrical Review (London), September* 14.

Accurate Speed, Frequency and Acceleration Measurements.

The various methods which have been used for measuring speed are discussed here by Dr. C. B. Drysdale. The older methods are held to be crude, and were discarded some time ago for an electrical method employing a Faraday disc. In this a magnetic field was set up by two circular iron cheeks attached to the poles of a permanent magnet, thus forming a narrow circular space, within which a copper disc revolved. Contact was made with the outer surface of the disc by means of a few drops of mercury placed in the lower part of the circular opening. A voltmeter gave indications of the speed. Although simple, this apparatus was unsatisfactory, due to the uncertainty of the contact resistance. An improved form using an inductor generator with a hot-wire instrument has been suggested, but such instruments are generally not altogether satisfactory. After having tried a number of electrical and mechanical methods, Dr. Drysdale has returned to the use of the electrically driven tuning fork. He believes that apparatus of this kind is, on the whole, the most satisfactory. The chief objection is the difficulty of calibration. When vibrating rods are used each rod must be independently checked. He describes a method which he has employed for measuring speeds. A tuning fork of known pitch has attached to its prongs two slotted screens, which alternately open and close as it vibrates. This is mounted opposite the shaft of a small motor, upon the end of which is attached a black and white disc having a geometrical design, and the inner design is a white square surrounded by a black pentagon, which is in turn surrounded by a white hexagon. Without the latter is a circle of thirty triangular white points on a black circle. Viewing this disc through the slits of the tuning fork the square appears single for speeds of 1,500 and 3,000 revolutions; double for 750 and 2,250; triple for 500, 1,000, 2,000 and 2,500. The pentagon is seen single for 1,200, 2,400 and 3,600 revolutions; double for 600, 1,800 and 3,000 and triple for 400, 800, 1,600, 2,000, 2,800 and 3,200. The hexagon appears single for 1,000, 2,000 and 3,000 revolutions; double for 500, 1,500 and 2,500 and triple for 333.3, 666.7, 1,333, 1,667, 2,333 and 2,667. Each 100 revolutions is checked by the thirty-pointed figure. For the calibration of speed indicators this device is the most perfect and convenient that can be employed. It is possible to maintain its speed steady during the test and there is no need for using an electrically driven tuning fork. In this way speeds may be determined to an accuracy of one part in 10,000. If it be desired to determine intermediate speeds a conical roller may be attached to the motor and the disc caused to roll upon this. This device enables speeds to be read off directly with an accuracy of one-tenth per cent.—*Abstracted from the Electrical Review (London), September* 7.

Notes on Glow-Lamp Standards and Glow-Lamp Photometry.

It is advisable in photometric work to use a flame standard when measuring flames, and an incandescent lamp as a standard for work with such lamps. The latter practice has a number of useful advantages, one of these being the fact that by connecting both standard and test lamp to the same circuit, the effect of variations in voltage is, to some extent, compensated for. But J. S. Dow points out here that this method of compensation is not perfect, since, as a rule, two incandescent lamps, even of a similar class, are not affected in exactly the same way by a given change in pressure. To illustrate this, a comparison is given between two 100-volt lamps at voltages from eighty-seven up, and it is shown that a change of one per cent in the difference of potential causes a change of about one-quarter per cent in the ratio of the two lamps. When comparing Nernst, tantalum or osmium lamps with an incandescent lamp, the exact regulation of the pressure is much more essential. It is shown that a change of one per cent in the voltage will make a difference of as much as two and one-half per cent in the ratio of a tantalum and a carbon incandescent lamp. Another source of error is due to the fact that the filaments are frequently not placed symmetrically within the bulb, so that the centre of illumination is not the centre of the lamp. For this reason it is advisable to use as standard lamps those having a horseshoe type of filament, and to place these with the plane of the filament at right angles to the photometric bench. The fact that the centre of illumination and the centre of the lamp may not agree makes it desirable to adopt a certain distance between the lamps when comparing them. One point requiring attention in the photometry of incandescent lamps is accurate measurement of the voltage, for the candle-power varies about as the seventh power of the voltage. For this reason, in tests made at the Reichsanstalt, the current is measured, and not the voltage, the candle-power varying only as the fourth power of the current. Another effect which should be guarded against is a sort of hysteresis. If the lamp be burned for a time at a voltage higher than the normal, the candle-power is increased temporarily, and returns to its original value only after a considerable time. It was found that two 100-volt, fifty-candle-power lamps with large bulbs, which had been tested at ninety-five volts and had been run accidentally at about twice this value for a few seconds, showed an increase of four and one-half and seven per cent in their candle-powers, respectively, when burned at the normal working potential of ninety-five. This increase in candle-power was maintained for two or three hundred hours, and then began to die away. At the end of a month they were still about 2.2 and 4.2 per cent above their former values. This hysteresis effect is of importance in aging lamps intended for secondary standards. If burned at a voltage above that for which they are intended they should not be calibrated for some time after. Another factor affecting the candle-power of incandescent lamps is the temperature of the photometer room. Fleming found that a change of nine degrees centigrade might produce a change of one per cent in the candle-power of an incandescent lamp. It is thought that a study of the new metallic-filament lamps may lead to some improvements in the construction of incandescent standards. The tantalum lamp, for example, varies in candle-power only as the fourth power of the voltage. For this reason it is distinctly better as a standard than the carbon lamp. —*Abstracted from the Electrician (London), September* 14.

The Advantages and Disadvantages of Different Systems of Tramway Brakes.

A translation is given here of two reports submitted by M. Scholtes, director of the Nuremburg-Für h Tramways, and E. R. Bjorkegren, chief engineer of the Grosse Berliner Strassenbahn, to the Congress of the Union Internationale de Tramways et de Chemins de Fer d'Intérêt Local. These gentlemen constituted a committee, but were unable to come to similar conclusions, and therefore submitted independent reports. That of M. Scholtes is rather statistical and shows that out of 7,500 equipments 3,673 were electric brakes, 2,316 hand-brakes, the remainder being air-brakes. Examining the cost of operation of compressed air and electric brakes, the advantage is found to be in favor of the latter. The cost of installation and maintenance is also in favor of the electric brake. M. Scholtes therefore concludes as follows: In the choice of a braking system all the particular circumstances of the service should be taken into account. The application of the three systems—the hand-brake, the electric brake and the air-brake—should be carefully studied. Braking should take place without shocks. The equipment of the car should include two systems of brakes completely independent of one another. The brakes in general use should be such as not to cause fatigue to the driver. When, on account of the weight of the cars, on account of trailers, or on account of the difficulties of the route, the hand-brake can not rationally be employed, a mechanical brake should be used, preferably an electric brake. If the use of an electric brake for general purposes necessitates certain inconveniences, such as, for example, choice of too large a motor or too much graduation in the starting resistances, in such a case it would be well to employ a compressed-air brake. The use of the latter system would be a necessity in the case of the cars being heavy or running at a high speed, or in the event of trains including more than two trailers. M. Bjorkegren, while coming to the same determinations as M. Scholtes so far as the cost is concerned, holds that statistical studies are of minor importance in such questions. The main thing is to obtain a brake which will be the most reliable under all possible conditions. The disadvantage of the electric brake is that it does not act instantaneously, as does the air-brake, and it, therefore, does not give the driver the same confidence. Although the electric brake is cheaper to install and costs less to operate and maintain, when it is a question of running cars or trains consisting of heavy vehicles, he believes that air-brakes are to be preferred. He modifies the conclusions of M. Scholtes's report as follows: in the choice of a system of brakes all the particular circumstances of the case should be considered. The application of each of the three systems—the hand-brake, the electric brake and the air-brake—should be carefully studied. The brake for general use should allow for braking without shock, and should not cause fatigue to the driver. It should, at the same time, be suitable for use in case of emergency, and as such should work sufficiently rapid and with certainty. In addition to this brake for general use the equipment of the car should include a second auxiliary brake. When, on account of the weight of the cars, the use of trailers, or on account of the route, the hand-brake can no longer be rationally used as a service brake, a mechanical brake should be used, preferably an air-brake.—*Abstracted from the Electrician (London), September* 7.

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

ORGANIZATION AND CONDUCT OF A NEW-BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.[1]

BY W. RANDOLPH SWEANY.

The foundation of a new-business department, like everything else, depends upon its setting. The public expects to have its patronage appreciated, therefore it is necessary to be in a position to handle in a business-like manner any request coming from the consumer. Complaints should receive the same polite attention as orders for service. The greatest advertisement is a satisfied consumer. Except in rare cases, the operating man of the central station company is not qualified to treat with the consumer. In some instances they feel antagonistic owing to frequent reflections on the quality of service furnished. For companies of the size this paper concerns, it is not always found practicable for the head of the new-business department, generally known as the contract agent, to devote his time to the office, in which case for the convenience of the consumer and the public, an office presided over by one with a thorough knowledge of the business, together with keen commercial instincts, should be established for handling orders, complaints, etc. It is not advisable to associate the title complaint department with this office, as it is too suggestively inviting. As the business grows this office should be brought under the control of the person in charge of the new-business department, as it is necessary that this officer should be thoroughly in touch with the established business in order to intelligently prosecute a successful business-getting campaign.

The sale of electricity should be conducted along the same lines as any other staple, manufactured product. The number of solicitors employed in the new-business department, theoretically, should be governed by the greatest number that can individually earn a profit on themselves. This can be readily figured out.

Herewith is set forth a diagram showing a practical organization, with the line of connection and intercommunication.

[1] In the prize contest inaugurated by the Cooperative Electrical Development Association, this paper received an honorable mention.

The organization as shown on the diagram is composed of eight men, all of whom are productive. The contract agent is responsible for the growth of the business. He is assisted by seven others: one general office and publicity man, two special, and four district solicitors.

In cities with a population of 40,000, drop out two district solicitors from the number shown in the above diagram. Where the population is 30,000, drop out two district solicitors and the contract agent, the manager or superintendent assuming the contract agent's duties. With a population of 20,000, drop out two district solicitors, the contract agent, and combine the duties of the power and new-building agent with that of the sign and heating, etc., agent. For cities with a population of less than 20,000, the manager or superintendent can assume the duties of the contract agent and office man, and the soliciting force be composed of a special power and sign, etc., agent, and two district solicitors. If found necessary to further reduce the force owing to limited territory, one or both district solicitors can be dropped, retaining the special power, etc., agent.

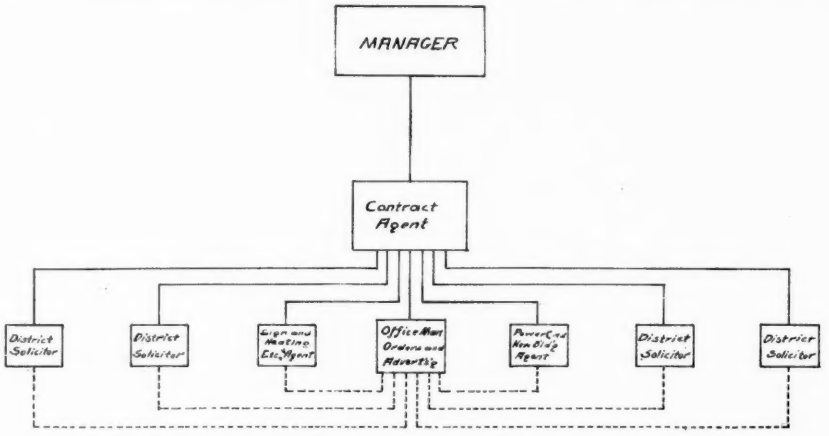


DIAGRAM SHOWING ORGANIZATION OF NEW BUSINESS DEPARTMENT.

The possibilities of a central station company's business are too great to neglect, by curtailing in the soliciting department. If economies must be practiced, first look elsewhere.

The qualifications of a successful contract agent are too numerous. He should have a technical and practical knowledge of electricity and mechanics in general, disciplinary ability, and extraordinary business capacity, combined with a strong personality; he must be able to inspire confidence, not only in the prospective consumer, but in the men under him. It is through this latter channel that he will obtain the best results. His duty is to keep himself and the solicitors abreast of the latest developments in the application of electricity. The entire contract department should assemble at least two evenings a month, to bring out talking points, review business secured, and talk over new plans. Interest must not be allowed to lag. He should as far as possible become acquainted with the company's consumers, keep in touch with all civic organizations, new developments and improvements. In addition to supervising the work of the solicitors and the publicity department, he should personally handle all the large contracts, or what might be termed the wholesale end of the business.

The position of office man, in charge of orders and advertising, should be filled by one conversant with the requirements of a general mercantile business: he should have at least an elementary knowledge of electricity and should be posted on the class of service furnished and the location of the company's lines. On him will fall the clerical work of the department, keeping records, compiling data, issuance of orders, and last but not least, the publicity or advertising work.

The power and new-building agent, shown in the diagram, should be selected

with great care and be of the highest grade obtainable. His qualifications are set forth in the following diagram:

Qualifications of Special Power and New-building Agent.	Technical training. Practical shop experience. Ability to estimate cost of operation under all conditions. Ability to draw up general specifications. Settled age. Good judgment. Salesmanship. Good character. Attention to detail. Persistence.

The duty of this special agent is combatting isolated plants, and handling all power propositions on installations of five horse-power and over; also close acquaintance with architects and builders, draughting of specifications on wiring, installing of light, power and heat; in general, soliciting all power business, together with contingent lighting. This agent starts with the building permit.

Should the city in question be a manufacturing centre, a district solicitor should be dropped and an extra special power, etc., agent employed.

The sign and heating, etc., agent, shown in the diagram, should have all the qualifications of a good salesman; no technical knowledge is necessary, yet he should understand the elements of electricity, appreciate the advantages of advertising, and be able to exploit same; his best education is experience, and if he is of the right sort his value grows with it. He should understand and be able to make mechanical drawings and have ability in free-hand sketching. The plain electric sign letter is not suitable in all cases; the majority of merchants prefer original and individual design in their signs. In addition to his duties as sign agent, he should introduce small motor-driven exhaust fans, coffee mills, meat choppers, etc.; also electric irons, coffee percolators, urns, griddles, etc.

The four district solicitors should have all the qualifications of the sign agent and, in addition, possess a practical knowledge of illumination. The lack of this knowledge will retard the sale of electric lights and generate the dissatisfied customer quicker than anything else. Each of these solicitors should be placed in a fixed territory and should be selected so that he is suited to the class of people he comes in contact with. It is better not to change territories if the solicitors meet all the requirements.

IN GENERAL.

A space in the general office, and the show-windows, should be devoted to display, demonstrating the different applications of lighting, small motors, and heating and cooking appliances; this will greatly assist in making popular devices that improve the day load.

The central station, to enjoy the business that belongs to it, should advertise. This is frequently done ineffectually and much money wasted. At a moderate expense a very effective, productive publicity can be maintained. A follow-up system of letters, interspersed with attractive folders with cuts and descriptions, will reach people not seen by the solicitors. Such things are bound to create a desire. When this is accomplished the consummation of the trade is left to the solicitors. These letters and folders can be bought from advertising concerns engaged in this line of business at less cost than if designed by the central station company and turned out by local engravers and printers. Such of these that go to consumers can be enclosed with the monthly bill, saving postage. It is best not to be too general in advertising; drive one thing at a time. The consumer using electricity for lighting only presents a good opportunity for the advertising department; signs, small motors, heating and cooking devices can be constantly brought to his attention, their application and usefulness shown.

In connection with the display part of the business, the central station company should be able to demonstrate the uses of each device it exploits. Although the sign business presents many difficulties, a business arrangement with one or a number of electric sign manufacturers is preferable. It pays to sell signs, heating and cooking appliances, sewing-machine motors, etc., from samples shown in the display room.

Only by sticking to system can the best results be obtained. A great many solicitors are prone to hit only the high places. Make a directory for the office, of consumers and prospective consumers, classify the business, see that all are approached, not once, but many times. Keep a card file of calls and results. Call on the old consumers; find out if they are satisfied; if not, suggest some appropriate change.

For the convenience of solicitors, loose-leaf books that can be carried in the pocket should be provided. These books should contain rules, formulas and data on all subjects pertaining to their business, such as the average consumption of lamps, motors, etc. Percentage of average load to connected load in different businesses, cost of all current-consuming devices, cuts showing the proper distribution of light, etc.

Regarding the necessary forms in the new-business department, a check on the solicitors, their calls and appointments is best kept by the card-file system. For the solicitor, a calendar is used for appointments. The following is a form for calls and results from which is taken a monthly or bi-monthly summary, showing business secured, business lost, its cause and prospective business:

DUPLICATE

CONTRACT DEPARTMENT CALL REPORT No.....

THE.....ELECTRIC CO.

	Date.....*M*.....190...
Saw M.....	*Address* .....
Previous appointment.....	*Heard of from*.....*Seen at*.....
Present installation.....	*Business* .....
Called in reference to.....	.....
.....	
.....	
.....	
.....	
.....	
.....	
.....	
.....	*Date of next appointment*.....
Disposition	.....
Complaints	.....
Expense incurred.....	*Collections* .....
Agent	*Checked by*.....

The remuneration of solicitors should be on a fixed-salary basis and not salary and commission. The right sort needs no extra incentive. If he is entitled to an increase and the business justifies it, give it to him; if not, drop him if he is dissatisfied. Either the company or the

solicitor gets the worst of it on a commission basis. The interest must be mutual.

RATES.

It is not meant in this paper to refer to rates other than to say they are, of course, the largest factor concerned in regulating the amount of new business secured. They should be as simple as possible, published, not concealed, and with the exception of sign and show lighting, which can be placed on a switching circuit under control of the company, should be entirely on a meter basis.

Electricity is a mysterious force, and, as the steady-going public dislikes unknown quantities, a campaign of education is necessary, which, if properly and systematically carried out, will surely bring the desired results. The public is simply waiting to be taught the advantages the use of electricity offers. With it can be supplied light, power and heat, in innumerable ways. This the general public understands only in a vague manner. At least one of the three commodities is indispensable to every human being. The desire being created owing to the necessity, the advantages can be readily shown. Believe in it yourself, and you will inspire confidence; present it properly, and business must follow. Advertise! Solicit!

Rules for Wireless Telegraphy in Time of War.

At the closing session of the Institute of International Law, held recently in Ghent, Belgium, the following articles relative to wireless telegraphy were voted:

The regulations governing wireless telegraphy in time of peace are applicable in principle in time of war. Belligerents may prevent the transmission of Hertzian waves by a neutral state over the high seas within the sphere of their military operations.

All persons taken prisoners while receiving or transmitting wireless messages from belligerent territory or between different sections of a belligerent army are not to be considered spies, but are to be treated as prisoners of war, unless their operations were carried on under false pretenses.

Carriers of dispatches received by wireless who make use of concealment or ruse in their work will be regarded as spies.

Neutral ships and balloons proved to have been used to furnish an adversary with information helpful in the conduct of hostilities may be removed from the zone of hostilities and the wireless apparatus on board seized and sequestrated.

A neutral state is not obliged to prevent the passage across its territory of Hertzian waves destined to a country at war. A neutral state has the right to close or take over the wireless telegraphy station of a belligerent operated in its territory. Every prohibition in the matter of wireless communication made by belligerents must at once be communicated to neutral governments.

"Wood Preservation."

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your issue of August 25 last, a very interesting notice appears, abstracted from the *Transit* of Iowa, on the subject of wood preservation. We venture to think that some of the conclusions arrived at are open to criticism, particularly the advantages which are supposed to accrue from steaming or the seasoning of wood in water. In regard to the former, while the steaming process may usefully coagulate the albuminous matter in the sap it also decomposes many of the natural juices of the timber, thereby injuriously affecting its strength as well as providing nourishment for fungal attack. Wood thus treated is "dead," and although rapid drying is accomplished the wood is neither seasoned nor preserved. In regard to seasoning by immersion in water, there are some advantages in connection with this method, but at the best it is incomplete, and in addition to seriously discoloring the wood, shakes are often developed, and, as the pores of the wood remain open, dry rot afterwards easily sets in.

The methods for preserving wood, afterwards referred to in this notice, have been more or less largely used and they certainly have some merit.

As it has been long recognized that effective wood preservation can only be accomplished by thoroughly impregnating the wood, the substance to be utilized must be antiseptic, fairly liquid or soluble, and inexpensive.

A process has recently been introduced into this country which seems to meet these requirements; the basis of the solution used is sugar. Professor G. S. Boulger, F. L. S., etc., whose name is well known in the States through his manual "Wood," says of this process: "Sugar, especially beet sugar, is a simple, stable carbohydrate, incapable, in the absence of soluble nitrogenous matter, of nourishing septic organisms. When in solution it has a high boiling point, and has been shown experimentally to have a greater power of diffusion through the wood than water has. Some of the sugar is so absorbed by the tissues of the wood as not to be readily parted from them; and, as at the same time it is not visible under the microscope in the interior of the wood, either as crystals or as drops of syrup, it is probably in some such loose molecular combination with the walls of the histological elements of the wood as water is in the walls of living cells. Its high boiling point gives it a penetrating power which enables the pressure employed in so many other processes to be dispensed with; and, while to some extent mechanically filling up the pores of the wood, it produces no grittiness, and even improves the surface of the wood for paint or polish."

This process is being adopted in this country for the treatment of all kinds of woods from paving blocks to the finest furniture woods. By it timber can be seasoned in a few days from being cut down and rendered equal, if not superior to that which has been "naturally" seasoned for years.

THE POWELL WOOD-PROCESS SYNDICATE, LTD.,
E. R. SCAMMELL, Secretary.

London, England, September 26.

Annual Report of the New York, New Haven & Hartford Railroad.

The annual report of the New York, New Haven & Hartford Railroad for the year ending June 30, 1906, has been issued. The gross earnings from operation were $52,984,322; the operating expenses, $35,222,586; net earnings, $17,761,735; income from other sources, $2,175,757; total income, $19,937,493; net income, after deducting taxes, rentals of leased lines and interest, $10,186,377. After paying dividends there was a surplus of $3,713,288.

President Mellen announces, concerning the work of electrifying the Harlem end of the New York division, that the actual initiation of electrical operation will be delayed on account of slow deliveries of material, but the electrical operation should begin before the close of the present year.

Concerning the reduction of fares, President Mellen is quoted as follows: "On January 13, 1906, the directors authorized a reduction of local passenger fares to a maximum of two cents per mile, figured in multiples of five. We are justified, from the returns at hand, in stating that the business has been stimulated to such an extent that an increased income, both gross and net, is assured as a result of the policy."

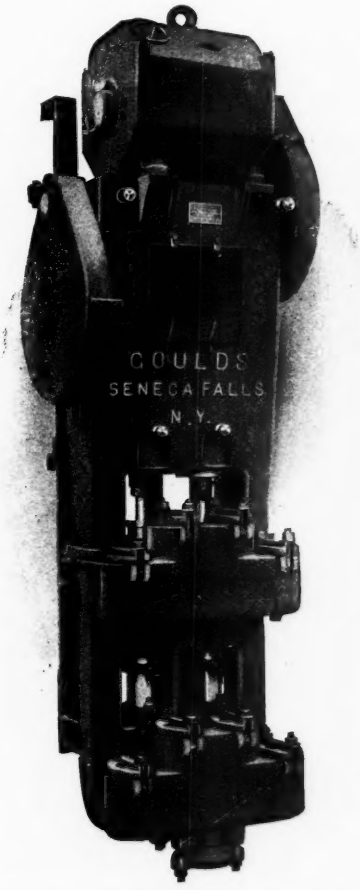
Concerning the opposition in Massachusetts to the ownership by the company of the securities of certain street railway companies in that state, President Mellen states that a sale was made on June 25 of such securities to the New England Investment and Security Company. Mr. Mellen declares that "it was useless to continue the investments and be a target of attack and misrepresentation that would have been the result."

INDUSTRIAL SECTION

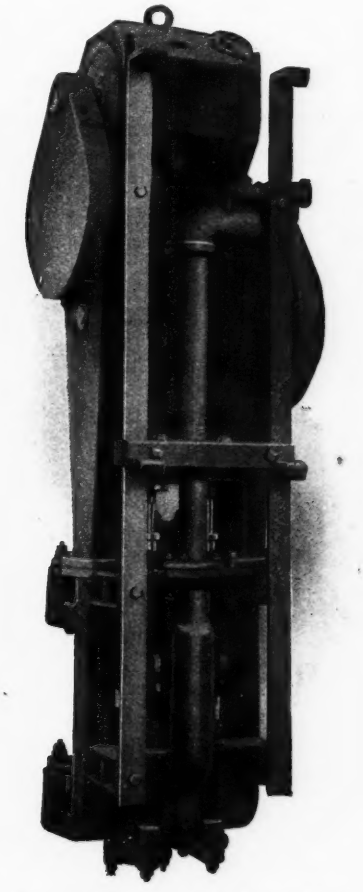
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Goulds Electric Mine-Sinking Pump.

In many applications to mine sinking the electrically driven pump has been utilized to great advantage. Where the service required calls for pumping from the mine bottom to the mine pump or to the station pump the flexibility of the electrical control, the compact arrangement of the motor-driven pump and the exposure to which the apparatus can be subjected not be injured by abrasion or falling rocks. All parts of the pump and motor are easily accessible through ample handhole plates. The working pressure is 130 pounds or 300 feet elevation. The capacity is 5,640 gallons to 10,320 gallons per hour. With plungers of four and one-half inches diameter and six inches stroke, at sixty revolutions, the capacity is generally ninety-four gallons per minute. This pump, with a four-inch suction and three-



FRONT VIEW, GOULDS ELECTRIC MINE-SINKING PUMP.



REAR VIEW, GOULDS ELECTRIC MINE-SINKING PUMP.

have made these devices of exceptional utility.

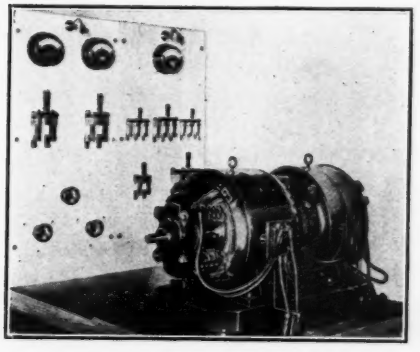
The accompanying illustrations show a front and a rear view of an electric mine-sinking pump made by the Goulds Manufacturing Company, Seneca Falls, N. Y. This is an electric double-acting sinking pump, outside packed. The motor gearing and all working parts are protected by a strong casing, so that the motor can

inch discharge, requires a fifteen-horse-power motor for a 300-foot elevation. With plungers of six inches diameter and six inches stroke, at a speed of sixty revolutions per minute, the capacity is generally 172 gallons per minute. With a suction of five inches and a discharge of four inches the motor required for a 300-foot elevation is rated at twenty-five horse-power.

The Multiple-Voltage System of Motor Control in New England Cloth-Printing Establishments.

The accompanying illustration shows the multiple-voltage balancing set as installed by the Allis-Chalmers Company, Milwaukee, Wis., in several New England cloth-printing establishments. The successful operation of these installations has developed a wide field for the application of electric motors in this industry, installations having been made in the United States Finishing Company, Norwich, Ct.; the Algonquin Printing Company, Fall River, Mass.; Glenlyon Dye Works, Phillipsdale, R. I., and the Arnold Print Works, North Adams, Mass.

The business of cloth-printing is an extensive one, and in most cases is done



MULTI-VOLTAGE BALANCER SET AND SWITCHBOARD.

under contract, the mill supplying the cloth as it comes from the looms to the finishing company, which does the printing and puts it in proper condition for the market. The cloth-printing machine consists of a large revolving cylinder, around which the cloth passes; and, bearing against the cylinder, with the cloth between, are one or more—sometimes as many as ten—copper rolls, called printing rolls, upon which the design has been engraved, the number of rolls being dependent upon the number of colors used. These rolls, in revolving, take up from a trough certain colors which are impressed in design upon the cloth. From the printing machine the cloth passes through drying rooms heated by steam to a high

temperature, emerging with the ink entirely dry.

Previous to the adoption of the electric motor the printing machines were usually driven by twin-cylinder engines direct-coupled to a main driving shaft. The variation in speed was obtained by hand-throttling the engine. The printing room was encumbered with line shafting and belting, with its accompaniment of dust and dirt-carrying possibilities. With the old system of operation the exhaust steam from the engines was used for heating water for the dye works and for other purposes, but it is said that the gain has been so great that live steam may now be used economically for these purposes.

The usual method of equipping a printing machine is to install the motor on the floor below the printing room and belt it up to a driving pulley on the main shaft of the machine.

On account of the very slow speeds required at different times the four-wire multiple-voltage system is selected in preference to the three-wire system. To obtain the slowest speeds a few steps of armature resistance are used, and this has necessitated the development of a special type of controller. This controller will give eighteen speeds, the very slow speeds being obtained through the use of armature resistance.

The power necessary to drive the printing machine depends upon the number of colors for which it is built, and, in addition, the pressure necessary to force the ink into the cloth being printed. Experience has demonstrated that for a machine built for three colors or less a seventeen and one-half-horse-power motor is well adapted, and for any greater number of colors a thirty-horse-power motor is recommended.

A New Capstan Cable Jack.

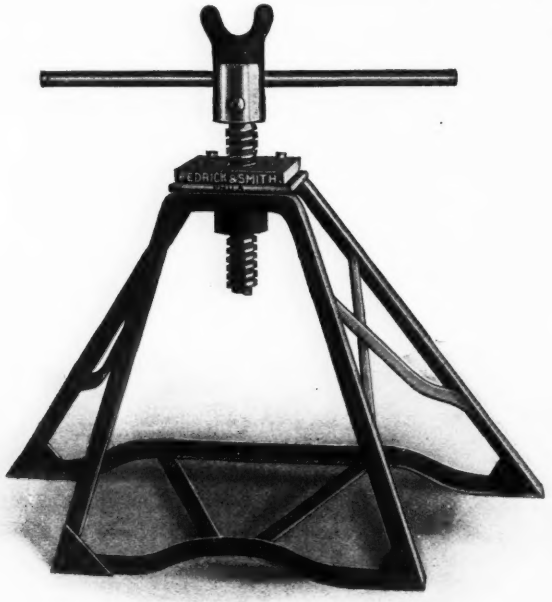
The accompanying illustration shows a new form of structural steel screw capstan cable jack which has recently been placed upon the market. Much trouble has been experienced in utilizing cable jacks for handling heavy drums, because of the cumbersome nature of the apparatus and the great weight generally attached to these machines. The device illustrated herewith is claimed by the makers to serve every purpose for which it is designed, and while strong and capable of handling the heaviest drums, it is readily portable, weighing but sixty pounds. When the drum is revolving no vibration is noticed.

The stand is formed from strongly braced steel angles. The jacks are used in pairs, one on each side of the drum, which revolves on an axle. The illustration shows a jack ready for the drum. The side that faces in the direct foreground is the side that stands next to the drum. This is referred to as the inner support, the opposite side being referred to as the outer support. The inner support is constructed to take up as little room as possible. There is but little slope —about one and one-half inches from the perpendicular. This feature adds strength, as it allows the drum to revolve very close to the supporting jacks. The spread of the jacks covers fourteen inches, which does not interfere with the man operating the drum. This enables the placing of the drum nearly over the manhole or aperture into which the cable is being laid.

The supporting feature is vested in the outer support. The slope of the outer support from the drum is five and one-half inches from the perpendicular. Its spread is thirty-six inches, assuring a condition of stability and equilibrium.

The screw is of heavy pitch and will elevate the drum rapidly with little effort.

The apparatus is manufactured by Pedrick & Smith, Church Lane and Philadelphia & Reading Railway, Germantown, Philadelphia, Pa.

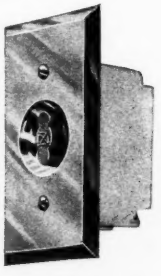


A New Capstan Cable Jack.

A 250-Volt, Double-Pole Rotary Flush Switch.

In response to a demand from a number of prominent engineers and architects, the Marshall Electric Manufacturing Company, Boston, Mass., has designed, and for some time has had on the market, a rotary flush switch which, it claims, is meeting the latest requirements.

The first peculiarity of this design is the fastening of the face-plate solidly to the back of the switch by screws, doing away with the arrangement of having the plate fastened by the handle, which, it is said, strains the mechanism and allows the plate to become lopsided after a short period of use. These face-plates are made from cast metal somewhat thicker than the usual custom.



Ten-Ampere, 250-Volt, Double-Pole Rotary Flush Switch.

The switches are furnished with handles, the ends of which are exactly even with the face-plate, so that nothing can be hung or fastened to the handles when the switch is in position. When an ordinary type of extending handle is desired, this can be furnished for this switch.

Another feature is the use of a fibre false plate, which is attached to the switch when it is sent out, and which securely seals the mechanism from plaster and dirt between the time of installation and the attachment of the finishing plate. These switches are now carried in stock at the New York office, 227 Fulton street; the Chicago office, 169 Adams street, as well as at the Boston works.

The Manufacture of Storage-Battery Plates.

The accompanying illustrations are interesting as showing the mechanical construction of the plate used in the well-known Gould storage battery.

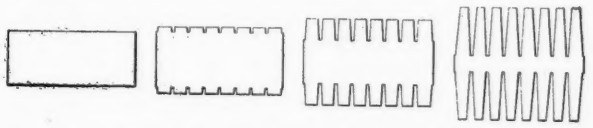


FIG 1.—FRAGMENT OF PLATE SHOWING MANNER IN WHICH CONTACT SURFACE IS FORMED.

The Gould plate is of the Planté type, in which the active material is formed electrochemically out of the lead composing the supporting plate of contact surface. Fig. 1 is a fragment of a Gould plate, illustrating the manner in which the large contact surface for the active material is developed out of a sheet of rolled lead cut to the size and shape of the plate. This blank is placed between two shafts, on which are mounted sets of rapidly revolving steel discs with spacing washers. These washers are pressed against the plate and moved to and fro, working into the lead further and further, and spinning the metal up between the discs into thin parallel ribs.

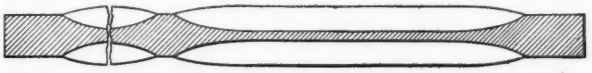


FIG. 2 —LONGITUDINAL SECTION OF PLATE, SHOWING WEB OF METAL LEFT AFTER SPINNING.

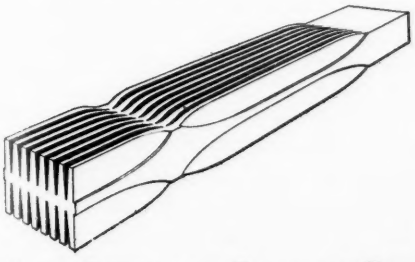


FIG. 3.—PERSPECTIVE OF FRAGMENT OF FINISHED PLATE.

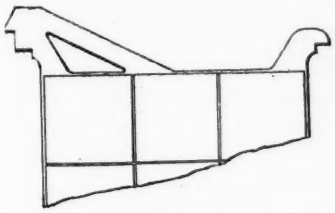


FIG. 4.—OUTLINE OF PLATE SHOWING DOUBLE CONDUCTING LUG.

Fig. 2 is a longitudinal section of a fragment of a plate and shows the web of metal left as a central conductor, and also the diamond-shaped cross-conductors and current-distributing bars.

Fig. 3 is a perspective drawing of a small fragment of finished plate, and clearly indicates the character of the construction. The active material is formed out of the lead composing the contact surface between the ribs, filling the spaces with closely compacted but highly porous active material.

Fig. 4 shows the double conducting lug, by means of which a large distributing surface is secured.

A San Francisco "Branch Office."

The accompanying illustration shows the establishment of the John R. Cole Company, 766-770 Folsom street, San Francisco, Cal., which was constructed and occupied in six weeks after the earthquake and general disaster. The company is one of the progressive manufacturers' agencies on the Pacific coast and represents the following interests: American Circular Loom Company; Harvey Hubbell, Inc.; George F. Brunt Porcelain Company; New York Insulated Wire Company; Bossert Electric Construction Company; Cutter Electrical and Manufacturing Company, and the Chase-Shawmut Company. A special consignment of building material was obtained, and the galvanized sheet iron which was used enabled the construction to be rapidly accomplished. The absence of show-windows and other superfluous paraphernalia as generally observed by commercial establishments is a conspicuous feature. This company is practically a branch of the several manufacturers which it represents, consequently it carries large stocks of each of their products, and as soon as the building was constructed new consignments were on hand, so that the actual interruption of the company's business was something less than six weeks.

A SAN FRANCISCO "BRANCH OFFICE."

A Large Installation of Gas-Engine-Driven Generators for Traction Purposes.

The Allis-Chalmers Company, Milwaukee, Wis., has secured a contract for gas-engine-driven electric power equipment for the Milwaukee Northern Railway, the southern terminal of which will be located at Milwaukee, Wis. The engineer and contractor for this new interurban line is the Comstock-Haigh-Walker Company, Detroit, Mich. The equipment ordered from the Allis-Chalmers Company comprises three twin-tandem gas engines, 1,500 horse-power, direct-connected to three 1,000-kilowatt, three-phase, twenty-five-cycle alternators, together with gas-

driven exciter sets and complete equipments for eight substations.

The present northern terminal of the system will be at Port Washington, Wis. It is expected that cars will be in operation by June, 1907. The main powerhouse is at Port Washington, and sites for substations have been provided at Burleigh, Cedarburg, Georgia avenue, Marblehead, Brown Deer, Cedar Grove, West Bend and Campbellsport. As soon as grading and construction work between Milwaukee and Port Washington is completed, work will be begun from Cedarburg to Fond du Lac. The route from Port Washington to Milwaukee is over a private right of way for almost the entire distance.

Gasolene-Electric Apparatus for Moving a Drawbridge.

A year ago, when the lake traffic was resumed, the cities of Houghton and Hancock, Mich., experienced an unlooked-for accident by being suddenly deprived of their bridge connection. This not only inconvenienced the public in general, but blocked one of Uncle Sam's highways of commerce, prevented street car companies from making through connections, and compelled a steam railroad company to change its schedule and transfer its passengers and freight by ferry for a whole year. The cause of this unlooked-for and costly event in the history of a busy centre was "lack of steam pressure" when the bridge operator wished to open the draw. The usual whistle was given him by a large freighter, but the operator, who was busy with his "getting-up-steam proposition," failed to give his danger signal, and the result was that the freighter struck the draw, and the bridge was thrown across the channel, a wreck.

The county commissioners and representative engineers of the steam and electric railroad companies, having placed the contracts for the removal of the wreckage and reconstruction of the bridge, were not desirous of another such experience with a steam outfit, and after deliberation over a number of bids and schemes the contract for motive power was awarded to Fairbanks, Morse & Company, of Chicago, for gasolene engines, electrical equipment and scheme of operation.

The new bridge structure is a double-deck draw, having the steam railroad tracks on the lower deck and the street car track and foot passenger walk on the upper deck. It measures 290 feet over all and weighs 800 tons. The operating house is placed at the top of the centre tower above the highway. A Fairbanks-Morse motor operates the end-lifts on each end of the draw, and two larger motors connected by gearing to the rack constitute the power for turning purposes. The power for operating these motors is obtained from one of several sources which have been arranged for in the operating house. The motors on the lower deck are operated by a series-parallel controller, placed centrally in the operating house.

Two twenty-five-horse-power gasolene engines direct-connected to dynamos are installed in this operating house, and a storage battery has been placed on the balcony of the room.

A white Italian marble switchboard has been furnished, and by a specially designed switch it is possible to obtain power from any one of six sources, as follows:

Battery only (which is capable of turning the bridge thirty times on one charge).

No. 1 generator and battery together.

No. 1 generator.

No. 2 generator and battery together.

No. 2 generator.

Both generators in parallel.

As a seventh and last resource, provision has been made to charge the battery from the trolley circuit, which is directly under the operating room.

The special switch is so arranged that only one combination can possibly be made at a time, and therefore no fear of disaster need be entertained through inexperienced handling.

The contract called for the bridge to be opened in one minute, whereas it is possible to open it in one-half minute if the emergency should arise. The engines can be started up from rest, dynamos brought up to voltage, and motors operating in less than three minutes, which is more than ample time required for general operation.

Electrical Developments in Japan.

We have from time to time noticed the prominent place which the electrical and cognate industries occupy in the rapid development of Japan, and a report on the trade of the consular district of Yokohama, issued by the foreign office, truly reflects the activities indicated in our previous notices. A feature of the report is the increased imports of tools and machinery, which is suggestive of several items in Japan's industrial expansion. Particularly noticeable, however, are the increases in electric motors (from $475,995 to $838,995) and electric light apparatus, gas engines, etc. Among the principal items of import at the port of Yokohama during the year 1905 were 7,368 tons of telegraph wire, valuing $374,345. The value of the electric light apparatus imported was $195,910, as against $147,645, an increase of $48,265. This increase eclipses even the steady average—$36,285—maintained between the years 1900-4. As we have already pointed out, the imports of electric motors show a noticeable increase of $363,000; gas engines were imported to the value of $43,435, an increase of no less than $22,035 within one year; while steam engines and boilers maintain a steady advance, without, however, attaining the high average increase registered between the years 1900-4. $334,850 worth of electric light wire was imported at Yokohama during 1905, comparing with $325,385 for the previous year; submarine and underground telegraph cables, however, show a decrease in the value of import to the amount of $249,925. One of the disquieting features about the figures contained in the report is that, with the exception of submarine cables, nearly all the imports of electrical machinery and apparatus came from the United States or Germany. Of course, it may seem in the nature of a truism to observe that such a state of affairs must be dependent upon many factors. Yet we can not repress the thought which suggests that one of the most important factors—that of enterprise and "go," as our American friends would term it—is not sufficiently applied by our manufacturers. With our home market cut up by competition, fostered by the absence of a tariff wall, our hope lies abroad, and what Sir William Mather last week told the shareholders of Mather & Platt about his firm's entry into the highly protected markets of terror-stricken Russia, can surely be copied in an enlightened and sympathetic country as Japan. We also learn from a French source that hydroelectric works are well under way in that empire. At the present moment a station is being constructed with a power of 19,500 kilowatts to serve the town of Tokio. Five Pelton turbines are being installed of 3,000 kilowatts each, driving direct 6,000-volt, twenty-five-cycle alternators. Current at 40,000 volts will be transmitted from the falls to Tokio, a distance of forty kilometres, and later it is intended to increase the voltage to 60,000. Japanese capitalists have approached the minister of agriculture for the concession to utilize two waterfalls in Korea for the generation of electricity. A thirty-year concession is sought for, after which the works will revert to the Korean government.—*Electrical Engineer (London)*.

Current Electrical News

DOMESTIC AND EXPORT.

NORTH GEORGIA ELECTRIC COMPANY TO INCREASE STOCK—The capital stock of the North Georgia Electric Company will be increased from $5,000,000 to $7,500,000. The company has obtained a franchise to distribute current in Atlanta.

ELECTRIC CONSTRUCTION CONCERN FORMED—The Electric Operating Construction Company of New York City has been incorporated with a capital of $1,000,000. The directors are: A. D. Bowen, San Francisco; Maurice A. Viele, George C. Hutchinson, of New York; R. S. Masson, Los Angeles, and W. D. Beardsley, of Nyack.

RIO DE JANEIRO TRAMWAY LIGHT AND POWER COMPANY—The Rio de Janeiro Tramway, Light and Power Company is ready to deliver 3,500 horse-power from a temporary plant, and the big plant under construction from which 48,000 horse-power will be secured will be in operation within fifteen months. Conditions favor an immediate market for all the power the company will have available.

MUNICIPAL OWNERSHIP IN ATLANTA—The agitation for municipal ownership of gas and electric plants in Atlanta, Ga., continues, led by Alderman Kay and other citizens. A municipal ownership league is forming. The proposition is for the city to issue bonds and begin by building a municipal lighting plant for its own use, to be extended to include a general lighting and gas system. There is also a sentiment in favor of taking over the street railway, but no definite campaign is made in this direction.

MANHATTAN RAILWAY COMPANY TO ISSUE NEW STOCK—The state railroad commission has granted permission to the Manhattan Railway Company of New York, to issue $4,800,000 new stock for construction and equipment. A good part of the money to be received from the sale of stock has already been expended on the elevated lines. The commission has granted permission to the New York & Queens County Railway Company to issue a mortgage for $10,000,000. Under the order of the commission only $8,000,000 can be issued by the road at this time. All but $2,000,000, which is for the refunding of existing mortgages, is for new power-houses and equipment and the reconstruction of a portion of the road.

SOUTHERN PACIFIC TO INSTALL AN ELECTRIC SYSTEM—The Southern Pacific has begun the work of installing an electric system on its line over the Sierra Nevada Mountains for the purpose of helping the heavy freight trains up the steep mountain grades by means of electric motors. Details have not yet been given out, but it is said that the engineers will settle upon the third-rail system. The installation of this system is a radical change in railroad operation in the West. At present freight trains are divided into several sections, and then require two and three engines, with corresponding large crews to haul them up the steep mountain grades. Powerful electric motors will take the place of the engines under the electric system.

STREET RAILWAY CONSOLIDATION—John G. Webb, president and owner of the Columbus, Delaware & Marion Street Railway, which operates street car lines to Marion, Ohio, and which is building an extension from Marion to Bucyrus, Ohio, has been in conference with E. W. Moore, of the Everett-Moore syndicate, with the object of arranging a consolidation in order to establish a through line with Columbus and lake points. The new link contemplated will also connect the Everett-Moore system and the Schoepf system of street railways in Ohio. The street railroads directly involved are the Lake Shore Electric, with $7,500,000 of stock and $7,500,000 bonds; Sandusky, Fremont & Southern, with $2,000,000 of stock and $2,000,000 of bonds; and the Columbus, Delaware & Marion, with $3,000,000 of stock and $3,000,000 of bonds, representing a total of $25,000,000 of securities.

RAILWAY CONCESSION GRANTED IN BOGOTA TO AMERICAN CAPITALISTS—The government of the capital district of Bogota has granted an important and valuable concession, extending over a period of sixty years, for an electric tramway or street car franchise, with exclusive rights, to the streets of Bogota and the roads of the district. This company, incorporated under the laws of New Jersey, and known as the Bogota Street Railway Company, has held a franchise for some years in Bogota which would expire in the comparatively near future. The service is now with mules, but the new franchise calls for electric or other means of more rapid transit. In view of the large amount of money that must be invested to make the necessary changes and improvements, the company sought a new franchise covering a long period, which has been granted.

MERGER OF MEXICAN PROPERTIES DOUBTFUL—According to Alfonso O'Kelard, manager of the Compañia Industrial de Guadalajara, the French Light and Power company of Guadalajara, Mexico, interests identified with La Electra, S. A., the Spanish company, have raised their offer for the French light and power business in that city nearly $1,000,000 since the offer of $1,600,000 was made. It is understood that the exact amount of the last offer made by the Spaniards was $2,500,000. This offer has been likewise refused. Mr. O'Kelard said: "An offer more than fifty per cent in excess of $1,600,000 has been made by interests identified with La Electra, S. A., for the plants and business of the Compañia Industrial de Guadalajara. This offer we have refused." It is said that the Spanish interests are unwilling at this time to pay more for the French holdings, and a consolidation of the light and power interests of Guadalajara now seems doubtful.

PHILADELPHIA COMPANY STOCK ISSUE—The proceeds of the sale of the $3,240,000 of the common stock of the Philadelphia Company made recently at par to the stockholders, are to be used in part to pay $800,000 of notes given for the purchase of the capital stock of the Beaver Valley Traction Company, and also to pay for the capital stock of the Washington & Canonsburg Railway, to the amount of $475,000. The remainder of the proceeds of the issue is to be applied in payment of extensions to gas lines and in advances to other companies controlled by the Philadelphia Company for extensions and improvements as needed, and for corporate purposes. The Beaver Valley Traction Company is a Pennsylvania corporation having a capital stock authorized of $1,500,000 and issued of $1,075,000. Its authorized funded debt is $4,250,000, while the amount outstanding is $1,500,000. The Beaver Valley Traction Company owns and operates thirty-two miles of track connecting various towns and boroughs in the Beaver valley, Beaver county, Pa. The Washington & Canonsburg Railway Company is a Pennsylvania corporation with a capital stock of $1,000,000, of which all is issued. Its funded debt amounts to $650,000. It is a consolidation of the Washington Electric Street Railway Company, and the Canonsburg Street Railway Company, and owns and operates thirteen miles of track.

EXTENSIVE PITTSBURG TRACTION SCHEME—The same men who are backing the Carnegie, Oakdale & McDonald Street Railway Company, which intends to enter Pittsburg in the near future, crossing the Monongahela river, are back of a gigantic scheme to give the people of Pittsburg a new system of street railways, with elevated line and tunnel connections, in opposition to the Pittsburg Railways Company. The lines will cover most of the unoccupied streets of Pittsburg and Wilkinsburg, crossing some streets for which the Pittsburg Railways Company now hold right, considerable private property, and territory now covered by the plans of the Pittsburg Elevated Company. Some of the routes selected are in line with the old Mellon franchises, which were sold to the Pittsburg Railways Company several years ago. Most of the companies follow the names of the main streets or location, which it is proposed to traverse, such as Forbes and Halkett, Harriett, Glenwood, Glenwood avenue, Squirrel Hill, Hale street, Frankstown avenue, Portland street, Coral street. These will be applied for at Harrisburg on October 11. The following are the names of the elevated lines to be applied for on October 24: Water street, Wilkinsburg loop, Glenwood, Forbes connecting, City, Oakland, Lawrenceville, Pittsburg, and Wilkinsburg and Beatty street elevated railway companies.

NEW PUBLICATIONS.

SPECIAL REPORTS OF THE CENSUS OFFICE—ELECTRICAL INDUSTRIES, 1902—The Bureau of the Census, Department of Commerce and Labor, has issued, in one volume, the special reports showing the conditions of the electrical industries up to the completion of the census for 1902. This includes reports on the central electric-light and power-stations, street and electric railways, and telephones and telegraphs. Much of this information has already appeared in pamphlet form, the present volume being illuminated by numerous half-tone illustrations of power-stations, station interiors and physical applications of electrical apparatus. The volume is a very valuable compendium upon the present state of electrical development.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES—The prospectus for 1906-1907 of the Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., is ready for distribution. This prospectus contains the preliminary announcement of the anniversary meetings, addresses, lectures, exhibitions, department meetings, concerts, dramatic readings, courses of instruction, schools and other educational work which will be conducted by the institute and its departments during the year 1906-1907. The season of active work begins on Thursday, September 27, 1906, and closes on Saturday, June 1, 1907. The number of anniversary addresses, lectures and department meetings open to every member is 475, or about fourteen for each of the thirty-six weeks of the season. In the department of electricity there will be ten lectures on electrical subjects, a course of illustrated lectures on physical chemistry, six illustrated lectures on "The Use of the Electric Current in Chemical Analysis and in the Preparation of Organic and Inorganic Substances," six illustrated lectures on "Supersensible Radiations or Forms of Motion That Do Not Affect the Senses," and fourteen illustrated lectures on electricity. In the department of engineering there will be a series of illustrated lectures at the regular monthly meetings of the department, held on the third Thursday of each month.

DATES AHEAD.

American Electrochemical Society. New York city, October 8 and 9.

American Society of Mechanical Engineers. New York, N. Y., December 4-7.

American Street and Interurban Railway Engineering Association; American Street and Interurban Railway Association. Columbus, Ohio, October 15-19.

Empire State Gas and Electrical Association. New York city, October 12.

Illuminating Engineering Society. 44 West Twenty-seventh street, New York city, October 12.

Kansas Gas, Water and Electric Light Association. Lawrence, Kan., October 16-17.

Michigan State Electric Association. Grand Rapids, Mich., October 10-12.

National Machine Tool Builders' Association. New York city, October 23-24.

Old Time Telegraphers' and Historical Society. Washington, D. C., October 9, 10 and 11.

Railway Signal Association. Annual meeting, Washington, D. C., New Willard, October 16, 17 and 18.

NEW INCORPORATIONS.

HARRISBURG, PA.—Stoever Electric Light Company, Mount Joy. $5,000.

WAUSAU, WIS.—Wausau Electric Company. Capital increased from $75,000 to $150,000.

ALICE, TEX.—Alice & Rio Grande Telephone Company. $10,000. Incorporators: Felix Hobbs, J. S. Turner and Phil Hobbs.

DOVER, DEL.—People's Car and Electric Company, Mason City, Iowa. To own and direct electrical work of all kinds. $800,000.

CLEO, TEX.—Cleo Telephone Company. $5,000. Incorporators: C. R. Wiliams, Philip Herald, Charles E. Walker, E. E. Christie and others.

HARRISBURG, PA.—Brady's Bend & Butler Street Railway Company. To build a line from East Brady to Chicora, and from Chicora to Butler. President, John Daly.

OLYMPIA, WASH.—Missoula Light and Water Power Company, of Spokane. $400,000. Incorporators: A. H. Wethey, W. M. Bickford, J. K. Heslet, of Butte, and C. E. McBroom, of Spokane.

BELLEVILLE, ILL.—East St. Louis, Granite City, Alton & Suburban Railway Company. $2,500. Incorporators: L. C. Haynes, George V. Pierce, T. W. Gregory, F. H. Thomas and F. E. Allen.

MOUNTAIN VIEW, CAL.—Mountain View Gas and Electric Company. $50,000. Directors: William Neuroth, George Jagels, Fred Dreischmeyer, Jr., and Charles Buschinch, of Mountain View, and Angus McLeod, of San Francisco, Cal.

OKLAHOMA, OKLA.—The Lawton Interurban & Street Railway Company, of Lawton. $100,000. To build an interurban road between Lawton and Fort Sill, and to other points in Comanche county. Incorporators: Frank Broadwell, Frank McMasters, Phil McGrory, B. F. Bowman and George Short.

SPRINGFIELD, ILL.—Moline, Rock Island & Eastern Traction Company, of Rock Island. To construct an electric interurban road from Carbon Cliff to Rock Island, and from Rock Island to Galesburg. $5,000. Incorporators and the first board of directors: James F. Lardner, Frank G. Young, Joseph F. Porter, Herbert E. Casteel and Burton F. Peek.

PERSONAL MENTION.

MR. RALPH BACHE, superintendent at Bound Brook, N. J., for the Public Service Corporation will resign to take charge as manager of the Colorado Springs Electric Company, at Colorado Springs, Colo.

MR. JOHN SMITH, for the past two and one-half years manager of the Jacksonville, Mich., exchange of the Citizen's Telephone Company will retire and his place will be taken by Mr. C. R. Kehoe, formerly wire chief.

MR. E. T. PENROSE has resigned as superintendent and commercial agent of the West Penn Electric Company, and will leave Connellsville, Pa. Under his direction the company has recently been very successful.

MR. JAMES H. FOSTER, secretary-treasurer of the Evansville (Ind.) Gas and Electric Light Company, died at Evansville, on September, 19, aged sixty-two years. He was a graduate of Indiana University, class of '68.

MR. P. W. GREEN, who has been since December last cashier in the Augusta, Ga., exchange of the Southern Bell Telephone and Telegraph Company has been promoted to the post of cashier at the company's Jacksonville, Fla., office.

MR. R. S. LEBEAUX has been appointed manager of the New York office of the Marshall Electric Manufacturing Company, Boston, Mass., taking the place of A. F. Wilson, who has resigned to become associated with the Manhattan Electrical Supply Company.

MR. L. P. ANDREWS, president of the Sedalia (Mo.) Water and Light Company, the Sedalia Waterworks Company and the United Water, Gas and Electric Company, has been appointed receiver of the three companies by Judge John F. Phillips, of the United States Circuit Court.

MR. GEORGE W. WOOD, of Syracuse, N. Y., has been appointed construction engineer of the Central New York and Empire State Telephone and Telegraph companies. The position of superintendent of construction has been abolished and all employés of the construction department have been placed under the direction of Mr. Wood.

MR. R. D. HOLABIRD, of the Holabird-Reynolds Electric Company, Los Angeles, Cal., and the Holabird, Reynolds & Sayles Com-

pany, San Francisco, Cal., has been making a trip through the eastern states, visiting last week the Franklin Electric Manufacturing Company, of Hartford, Ct., for which company Mr. Holland acts as San Francisco representative.

MR. ALFRED S. BROWN, for many years an electrical engineer for the Western Union Telegraph Company, died at his home in New York city, on September 26. He began as an operator and worked his way through various positions until he became superintendent of the Eastern District. He held this position for ten years, until he was made chief electrician for the company. He is survived by a widow and two daughters.

MR. CYRUS O. BAKER and MR. JOHN J. CARTY and their families have returned to New York from a six weeks' sojourn at the country place of Miss Annie Russell, sister of Mrs. Carty, on the Maine coast. Both Mr. Baker, who is known as the "Platinum King" of the United States, and Mr. Carty, who is one of the leading telephone engineers of the world, greatly enjoyed their rest from the strenuous life of the metropolis.

MR. A. A. MILLER, the representative of the Westinghouse Electric and Manufacturing Company at Seattle, Wash., was a visitor to New York city last week. Mr. Miller was for a short time connected with the sales office of the Westinghouse company in New York city, and found much pleasure in renewing old acquaintances. He reports a very brisk demand for supplies of all kinds on the Pacific coast, and speaks enthusiastically of the outlook for business in his territory.

MR. HORATIO A. FOSTER, the well-known consulting electrical and mechanical engineer, has become associated with Mr. Lewis B. Stillwell, consulting electrical engineer, of New York city, and will remove his office from the Bullitt Building, Philadelphia, to Baltimore, where he will become resident engineer in charge of the office which Mr. Stillwell has recently opened in the Continental Building. Mr. Foster is the well-known author of Foster's "Electrical Engineer's Pocketbook," and he has also published a useful book relative to central-station accounting, of which subject he has made a special study. Mr. Stillwell has effected a contract with the United Railways and Electric Company, of Baltimore, under which he has assumed the responsibility for electrical and mechanical work in reconstruction and new construction, and will also take entire charge of training a competent force for the proper operation of the plant. Mr. Stillwell regards the organization and training of the force as a very essential feature in connection with the construction of power-plants. The Baltimore work Mr. Stillwell expects to complete within one year.

PROFESSOR DUGALD CALEB JACKSON, of the University of Wisconsin, has been called to the Massachusetts Institute of Technology to become head of the course in physics and electrical engineering left vacant by the resignation of Professor Louis Duncan two years ago. This post has since been occupied temporarily by Professor Clifford. The arrangement will continue until the beginning of the second term, when Professor Jackson will take up active work. Professor Jackson was born in Kennett Square, Pa., in 1865. In 1885 he graduated from the Pennsylvania State College and went to Cornell University for a two-year graduate course in electrical engineering. For two years he was vice-president of the Western Engineering Company, of Lincoln, Neb., and then became affiliated with the Edison interests as assistant chief engineer of the Sprague Electric Railway and Motor Company. Later he became chief engineer of the central district of the Edison General Electric Company. During this period he designed, built and operated many of the largest electric railway and lighting plants, and is now advising engineer for several large corporations. He was a member of the International Jury of the World's Columbian Exposition in 1893, and of the Association of Scientists at the Pan-American Exposition in 1901. He is a member of the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, and of the Société Internationale des Electriciens.

ELECTRICAL SECURITIES.

For the past week the tendency of the stock market has been steadily downward. While the movement has been irregular, with periods of good recovery, the sentiment has been unsettled, with a growing bearishness, resulting in considerable short selling. As compared with a week ago, prices show general declines. The monetary outlook as a stock market factor was practically a secondary consideration in the concern which was evident concerning the nominations for governor in New York state. The high level for call rates was only 7 per cent last week, against 10 per cent the previous week and 12 per cent and 40 per cent in other weeks of the month. There has been no change in news reflecting widespread industrial activity. The iron and steel demand is almost as unprecedented as is the demand for copper. Railroad earnings are on a record level, and the officials predict a general shortage in equipment, despite recent large additions.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 29.

New York:	*Closing.*
Allis-Chalmers common	17½
Allis-Chalmers preferred	41¾
Brooklyn Rapid Transit	76½
Consolidated Gas	138
General Electric	164½
Interborough-Metropolitan common	36⅛
Interborough-Metropolitan preferred	76¼
Kings County Electric	155
Mackay Companies (Postal Telegraph and Cables) common	71½
Mackay Companies (Postal Telegraph and Cables) preferred	71¼
Manhattan Elevated	145
Metropolitan Street Railway	105½
New York & New Jersey Telephone	127
Western Union	86
Westinghouse Manufacturing Company	155

Directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1½ per cent, payable October 15 to stockholders of record on October 5.

Boston:	*Closing.*
American Telephone and Telegraph	139¼
Edison Electric Illuminating	234
Massachusetts Electric	70½
New England Telephone	129
Western Telephone and Telegraph preferred	85

Philadelphia:	*Closing.*
Electric Company of America	11¼
Electric Storage Battery common	68¾
Electric Storage Battery preferred	68¾
Philadelphia Electric	8 15/16
Philadelphia Rapid Transit	28¾
United Gas Improvement	85½

An official of the Philadelphia Rapid Transit Company estimates the increase in gross earnings in September at $50,000.

Chicago:	*Closing.*
Chicago Telephone	116
Chicago Edison Light	146
Metropolitan Elevated preferred	66½
National Carbon common	85
National Carbon preferred	116
Union Traction common	—
Union Traction preferred	—

ENGINEERING SOCIETY.

WESTERN SOCIETY OF ENGINEERS—The Western Society of Engineers has announced the following tentative programme: Wednesday, October 17, "Smoke Prevention and Suppression," A. Bement; Wednesday, November 7, "Notes on Road Resistance," C. H. Hudson; Wednesday, November 21, "Waterproofing, Particularly as Applicable to Masonry and Concrete Structures," Edward W. De Knight; Wednesday, December 5, "Concrete Pipe Culverts," O. P. Chamberlain; Wednesday, December 19, "Gravity Switching Yards for Freight Traffic," M. H. North; Tuesday, January 8, 1907, annual meeting and annual dinner.

ELECTRIC RAILWAYS.

JAMESTOWN, N. Y.—The Chautauqua Traction line has been opened through to Westfield from Mayville.

NIAGARA FALLS, ONTARIO—An electric railway is to be built between St. Catherines and Niagara-on-the-Lake.

LOCKPORT, N. Y.—The grading work of the Buffalo, Lockport & Rochester trolley line has been completed from Medina to Middleport, and also in sections from Middleport to this city.

BUZZARD'S BAY, MASS.—It is stated that the proposed electric road between this place, Bournesdale, Sagamore and Sandwich will be constructed during the coming winter, and that the line will be in full operation early next summer.

COLUMBIA, S. C.—Work on the new electric line from Columbia college through the property of the North Columbia Land Company has been commenced. The line will extend two miles from the terminus of the Columbia college line.

DALLAS, TEX.—J. F. Strickland, president of the Texas Traction Company, which is to build the Sherman-Dallas interurban line, states that work will begin on the road within thirty days, all papers for the construction having been signed.

PITTSBURG, PA.—It is reported in Homestead that the Pittsburg Railways Company is back of a proposition to build a trolley line to Whittaker, on the hilltops near Homestead, by way of Duquesne Junction, Bellwood and Munhall.

SAN JOSE, CAL.—The Peninsular Electric Railroad Company has been active in Redwood City securing needed rights of way. As soon as a few remaining property holders sign the agreement the company will begin the work of construction.

CONNELLSVILLE, PA.—The West Penn Railways Company has opened its new line from Mount Pleasant to Greensburg, via Hecla, a distance of fourteen miles. A regular schedule has been placed in operation and passenger cars will be run every half hour.

ST. LOUIS, MO.—The preliminary survey on the proposed electric line from Mexico, Mo., to Perry, Ralls county, has been started. The line will run due north through a section from which much stock is shipped every week. The line may later be extended to Hannibal.

INDEPENDENCE, KAN.—Work has been begun on the Independence-Coffeyville interurban line. It is the intention to build to Cherryvale without delay and to have the entire line in operation in eight or nine months. The power-house will be located at Independence.

BIRMINGHAM, ALA.—The Tidewater Development Company, which proposes the construction of an electric railway from Gadsden to Tuscaloosa, has been granted a franchise through the city of Bessemer. It already holds franchises in most of the other municipalities of Jefferson county.

DAVENPORT, IOWA—A new interurban company headed by J. F. Porter, president of the merger company, and J. F. Lardner, general manager of the Tri-City Railway Company, has been formed which has for its purpose the building of an interurban line which will extend from the tri-cities to Galesburg, Ill.

WINCHESTER, KY.—The council has granted to the Central Kentucky Traction Company right of way through Winchester for its electric line to Lexington, and sold the city street-car franchise for twenty years to the company. The traction company has bought the present street-car system and will reorganize and improve the service.

ST. LOUIS, MO.—The Hillsboro, Kimmswick & Northern Railroad Company has filed its acceptance of the terms of the franchise as granted by the St. Louis county court from the southern city limits to Jefferson county, and deposited its bond for $5,000 required to hold the county harmless from damages in the construction of the road.

MONTGOMERY, ALA.—A meeting of the stockholders of the Alabama City, Gadsden & Attalla Street Railway has been called for October 15, in Birmingham, at which time a proposition will be entertained to issue $300,000 of first mortgage five per cent bonds to make addition to the road and equipment. A line is contemplated to Noccalula Falls, several miles from Gadsden.

MIDDLEPORT, PA.—At a meeting of the Middleport borough council the right of way was given the Eastern Pennsylvania Railway Company to construct a trolley line through the town. This line is to connect with the present line which has its terminus at Pottsville. The new branch will be six miles in length and will give a through trolley connection from Mauch Chunk to Orwigsburg.

LOUISVILLE, KY.—At the meeting of the board of commissioners of Floyd county at New Albany, rights of way were granted over roads of that county to the Louisville, New Albany, French Lick & West Baden Traction Company and to the Louisville & Northern Railway and Lighting Company, the intention of those companies being to build electric lines to Paoli, French Lick Springs and West Baden.

COLUMBUS, OHIO—Two petitions with 146 signers have been presented the county commissioners by citizens of Worthington and Clintonville, asking that the franchise of the Columbus, Delaware & Marion Traction Company be revoked unless it establishes a half-hour schedule between the former city and Columbus. The petitioners assert that under the terms of the franchise cars must be operated every half hour.

ST. LOUIS, MO.—R. D. Smith, president of the McKinley system of interurban railroads, says arrangements have been completed whereby the McKinley system, which operates in ten counties of Illinois and has 400 miles of trackage, will enter St. Louis within sixty days. The cars will enter the city by ferryboats from Illinois. Terminal facilities will be constructed on property of the McKinley system on the river front.

BOONVILLE, IND.—The Evansville & Cannelton Electric Railway Company has been organized to build a traction line connecting Evansville and Cannelton, both on the Ohio river. The officers of the new company are as follows: president, F. W. Cook; vice-president, W. H. McCurdy; secretary and treasurer, Marcus Sontag; directors, F. W. Cook, W. H. McCurdy, George A. Cunningham, Marcus Sontag, Gus Muhlhausen, C. C. Tennis and C. H. Battin.

BLOOMSBURG, PA.—Arrangements are being completed for the sale by the Delaware, Lackawanna & Western Railroad of the towpath recently acquired from the Pennsylvania Canal Company between Catawissa and Northumberland. It is understood that the purchaser is to be the Danville & Sunbury Electric Railway, which has acquired the privilege of extending its tracks between Northumberland and Danville. It is expected that the towpath will be used for the further extension from Northumberland to Catawissa.

VALDOSTA, GA.—Charles J. Peeler, president of the Georgia Land and Industrial Company, of Milltown, Ga., announces that his company has purchased the water power of the famous Banks mills at Milltown, and will begin soon the exploitation of the same. The company will develop the power for electrical purposes, furnishing lights for the town and power for manufacturers. By far the most important feature of the enterprise will be the building of an interurban trolley line from Milltown to Valdosta, which it is announced will be commenced in a short while.

WILMINGTON, DEL.—A trolley line from Wilmington to Chesapeake Haven, a resort in Cecil county, Maryland, on the Chesapeake bay, is proposed. The resort will be established midway between the Elk and Sassafras rivers, the trip by trolley from this city occupying one hour and twenty minutes. The Delaware Interurban Railway Company has a charter to build a road from Wilmington to Elkton and Chesapeake City, which is expected to be soon in operation. It is probable this line will be extended to Chesapeake Haven. The Chesapeake Land Improvement Company will establish the resort.

AUGUSTA, ME.—The board of railroad commissioners has approved the articles of the Rumford Falls & Bethel Street Railway Company, which is to be formed for the purpose of constructing and operating a street railroad in and through Mexico, Rumford, Hanover, Newry and Bethel, the same to be operated by electricity or compressed air. The length of the line will be thirty miles. The amount of capital stock is $120,000 and the subscribers to the capital stock are: Elliott W. Howe, Everett K. Day, Orville J. Gonya, William H. Raye and Dennis J. McCoy, of Rumford. The commissioners also approved the articles of association of the Augusta, Oakland & Waterville Street Railway Company. The proposed road will begin at Oakland, skirt each side of Messalonskee Pond to the

highway of West Sidney. Then it practically will follow the highway to the Bond Brook road in this city, except that it will make one small detour. The distance will be eighteen miles. The directors of the proposed road are Amos F. Gerald and Edwin J. Lawrence, of Fairfield; A. B. Page, of Shawmut, and Cyrus W. Davis, of Waterville.

PROVIDENCE, R. I.—The Norwich-Westerly road has been opened, the first car coming to Westerly from Norwich with Railroad Commissioner Seymour; President E. E. Kernon, of the Construction Company; Electrical Engineer J. N. Long, of the Westinghouse Electric and Manufacturing Company; Treasurer R. W. Perkins; President H. H. Gallup and Secretary C. D. Noyes. The trip was made in an hour and a half, which is twice the time arranged for the regular schedule. The cars will come to Westerly only as far as the West street bridge, which yet remains to be built. The orders for the iron work for the bridge have been in some time, but on account of the big demand for bridge structures some delay is being met with.

SPRINGFIELD, OHIO.—At a meeting of the Springfield Street Railway Company stockholders, W. H. Stackhouse was elected a director to succeed I. Ward Frey, who has moved to Joplin, Mo. Outside of this change the same board was elected that was in control of the company last year. Those elected are as follows: Oscar T. Martin, W. F. Foos, Charles L. Bauer, John H. Miller, H. J. Crowley and C. L. S. Tingley, the last two being from Philadelphia. The officers elected are: president, Oscar T. Martin; vice-president, H. J. Crowley; secretary and treasurer, C. L. S. Tingeley; general manager, John H. Miller. The report submitted by Mr. Miller was most pleasing, showing that the business of the company had increased greatly the past year.

TELEPHONE AND TELEGRAPH.

UTICA, N. Y.—The Bell Telephone Company has erected a new line from Lee Center to Rome.

FLORENCE, S. C.—The Southern Bell Telephone Company has begun the work of rebuilding the local telephone system.

ANAHEIM, CAL.—The Home Telephone Company has received five carloads of poles for its local system, and work will soon be commenced.

SAN FRANCISCO, CAL.—It is reported that a complete reorganization of the Pacific States Telephone and Telegraph Company will take place in the near future.

MOSHEIM, TENN.—The Mosheim & Little Chucky Telephone Company has been incorporated by L. B. Harrison, J. M. Hendry, C. F. Hartman, J. M. Cobble and A. J. Johnson.

COHOCTON, N. Y.—E. W. Sutfin, for many years lessee and manager of the local office of the Bell Telephone Company, has given up his lease and the business has reverted to the Bell system.

DAVENPORT, WASH.—At the meeting of the city council the matter of a franchise for a new telephone system in town was up for consideration, and it was decided not to grant another franchise.

BRIDGEPORT, W. VA.—The Belmont and National Telephone companies are laying a cable across the river at Bellaire that will improve the Belmont service from Bridgeport to Wheeling and from Martins Ferry to Wheeling.

DOLGEVILLE, N. Y.—The work of the Bell telephone in establishing its system in this village has been started. The exchange is already in such condition that the only work necessary there will be the installation of the mechanical appliances.

BURLINGTON, VT.—The board of aldermen of the city of Rutland has granted to the Home Telephone Company, of Albany, a franchise to locate and operate a plant in Rutland. It is the concern's first franchise in Vermont, but it proposes to try to get franchises in other cities at once. An office building will be erected in Rutland.

GAINESVILLE, GA.—The Southern Bell Telephone Company is preparing to extend its line from this point to Athens. The line will be a double circuit, one circuit being used by the public and the other exclusively by the Gainesville Midland Road. The circuit to be used by the railroad will give a combination telephone and telegraph service with telegraph offices at Gainesville, Belmont, Jefferson and Athens. The right of way of the Gainesville Midland road will be used on which to construct the line.

WEBSTER, N. Y.—The Bell Telephone Company has completed twenty-five miles of new construction and is adding seventy-five new subscribers to its list. A new switchboard has also been installed, and many other improvements made. A year ago Webster had only a little over two hundred subscribers, to-day there are over five hundred.

LAUREL, MISS.—The Cumberland Telephone and Telegraph Company has announced its intention to extend the line south to Richton, a distance of twenty-five miles, and north to Bay Springs, about the same distance. At Bay Springs, the line will connect with a local line, which will give the people of Laurel direct communication with Lake Como, Newton, and points north.

TRENTON, N. J.—Plans are being prepared for a handsome new building for the headquarters of the Trenton district of the Bell Telephone Company. The details of the building are not known at this time, but the plans will be completed in time to permit starting the work early next spring. The new building will occupy the site of the present office on East State street, together with the lot adjoining.

NEW HAVEN, CT.—It is expected that within a short time the directors of the Southern New England Telephone Company will announce a new issue of stock to the extent of $500,000. This will bring the capitalization of the company up to $5,000,000, an increase of $1,000,000 within a year. The money, it is stated, will be used for improving the service and making further extensions of the lines in the state.

GUEYDAN, LA.—A meeting of farmers and business men was held at Fisher's Hall recently, the object being to form an independent telephone company. The following officers were elected: H. L. Gueydan, chairman; W. M. Cowan, secretary. It was decided to organize a $5,000 stock company, to be called the Farmers' Mutual Telephone Company, Limited, for the purpose of building a line to Lake Arthur, Shell Beach and Klondike; another to Relief, about seven miles east of Gueydan; also a third line to a point five miles south of Gueydan. A large share of stock was subscribed.

HORNELL, N. Y.—At a special session of the common council a franchise was granted the Bell Telephone Company, which permits it to construct a system of conduits for its wires throughout the city. The franchise, as originally presented has been so amended as to allow the Hornellsville company to occupy the same trenches as the Bell, and it is provided that in such case they shall jointly defray the cost of excavation, refilling and replacing the streets. It is also provided that either company shall give the other sixty days' notice in case of a decision to build conduits, and that the company so notified shall, before the expiration of thirty days, give notification of its intention to occupy the conduits jointly. The franchise is for fifty years from January 1, 1907.

PHILADELPHIA, PA.—On property recently purchased at the southeast corner of Broad and Spruce streets the Bell Telephone Company will erect a ten or twelve-story office building and exchange, the estimated cost of which, including equipment, will be $1,500,000. The lot has frontages of ninety-five feet on Broad street and ninety feet on Spruce, and was purchased to relieve the strain on the exchanges at Seventeenth and Filbert streets and Eleventh and Filbert streets, and to provide for the expected heavy growth in telephone business. A new exchange at No. 1705 South Broad street, to be known as Dickinson office, will be completed early in the year and will take care of the business down-down. It can take care of 18,000 telephones. The Eleventh street office can handle 25,000, the Seventeenth street office 20,000, and the proposed new exchange at Broad and Spruce streets will have a capacity of 36,000. This will give the company practically 100,000 telephones between Eighth street and the Schuylkill south of Spring Garden street. A handsome two-story central office building has been completed this month at Chestnut Hill, at which 12,000 telephones can be operated. Besides these buildings the company has built in the suburbs of Philadelphia within the last two years a number of buildings to provide for future growth of the suburban telephone business on a most liberal scale and designed to give the best service.

ELECTRIC LIGHTING.

ALBANY, N. Y.—The town board of Whitesboro has granted a franchise to the Hudson River Electric Power Company to distribute light, heat and power in the town.

GRAND FORKS, N. D.—A permit has been issued for the construction of the Grand Forks Gas and Electric Company's power-building. It places the value of the structure at $28,000.

GREENFIELD, MASS.—The Massachusetts gas commissioners have authorized the Greenfield Electric Light and Power Company to issue $65,000 additional capital stock at par, the proceeds being to take up floating debt incurred by additions.

ELKTON, MD.—The county commissioners of Cecil county have granted a franchise to the Rising Sun Electric Light and Power Company to erect poles along the county roads. The new company which was recently formed proposes to light the town of Rising Sun by electricity.

ORILLA, CANADA—The municipal electric plant of Orilla, is reported to be a success. The power is developed twenty miles distant at Ragged Rapids, and is sold to the factories at $16 per horse-power per annum, and two cents per week per 16-candle-power lamp for incandescent lights.

NORFOLK, VA.—The Retail Merchants' Association, of Portsmouth, has agreed that in the event that its complaint of the inefficient service of the present lighting plant is not attended to promptly it will immediately take measures to establish a new lighting and power enterprise there.

VICTORIA, B. C.—The Dawson Electric Light and Power Company, recently sold under foreclosure of mortgage, has been taken over by N. A. Fuller, a Tanana and Dawson capitalist, and Dr. A. S. Grant, who are preparing to furnish power by a fifty-mile of transmission line from the Coal creek coal mines.

MANHATTAN, KAN.—A committee from the Manhattan Commercial Club has been appointed to investigate the possibilities of damming the Blue river at Rocky Ford, four miles north of Manhattan for the purpose of creating power to be utilized in operating an electric plant to furnish electric power in the city.

COVINGTON, IND.—The Covington Electric Light and Waterworks power-house was entirely destroyed by fire September 13. The loss is estimated at $20,000, with $5,000 insurance. A majority of the stock of the company was owned by ex-United States Treasurer E. H. Nebeker and H. C. Yount, of this city. They will rebuild at once.

SCRANTON, PA.—The Dunmore Electric Light Company has entered into a contract with the borough of Dunmore to furnish light to the borough for the next six years beginning October 1, at a cost of $72.50 a light. This is a reduction of $10 in the cost of each light annually, and will save the borough about $700 this year or about $7,000 during the life of the contract.

HART, MICH.—A trust deed in the sum of $200,000 has been filed with the register of deeds to enable the Pere Marquette Light and Power Company to procure cash to complete its dam and power plant now in the course of construction on the Pere Marquette river in Mason county. The mortgage is filed to the American Trust and Savings bank and Frank H. Jones, of Chicago.

EAST McKEESPORT, PA.—The United Electric Light Company, of Wilmerding, an independent company of the Turtle Creek valley, has closed a contract with the borough of East McKeesport for furnishing arc lights for the town at $60 per light per year. The contract is for five years. The price is the lowest in the county, with the exception of that granted Turtle Creek and East Pittsburg by the Rose Hill Electric Light Company, of Turtle Creek.

SALT LAKE CITY, UTAH—An application has been filed by A. M. Hill, A. P. Hanson and L. H. Gray, all of Salt Lake, for a flow of 110 cubic feet per second, to be diverted from the Blacksmith fork of Bear river, in Cache county. The diverting work will consist of a dam, headgate, and a pipe line. The diverting channel will be 8,000 feet long and one and one-half feet in diameter, and the flow will run two water-wheels, size yet to be determined, and will give power to operate machinery for an electrical plant on Blacksmith fork.

SALT LAKE CITY, UTAH—Benjamin E. Rich, of Centerville, has plans to furnish light and power in Davis county, and has filed in the office of the state engineer an application for a water right that will enable him to carry out his plans. Mr. Rich wishes to divert four second-feet of water from Farmington creek, and convey it by means of a channel, 600 feet long to the point where the power plant will be erected. One twenty-four-inch wheel is to be used, operating under a head of 480 feet and producing a total of 180 horse-power.

MANCHESTER, N. H.—At the annual meeting of the stockholders of the Manchester Traction Heat and Power Company, the following directors were elected: William A. Tucker, S. Reed Anthony, W. M. Parker, P. L. Saltonstall, J. Brodie Smith, George H. Hood, R. G. Sullivan, Charles M. Floyd, Stillman F. Kelley, B. P. Larned, R. H. Hallowell and W. Parker Straw. W. Parker Straw succeeded to the vacancy caused by the death of Harry E. Parker. The directors elected Mr. Tucker president, Mr. Smith vice-president, and Mr. Anthony treasurer.

SOUTHBRIDGE, MASS.—In connection with a plan of buying in heat and power plants in this section of the state the Boston Heat and Power Company has announced the purchase of the Southbridge Gas and Electric Light Company, of this town. The former company has already taken over several other companies. The plan is to increase and extend the lighting service in Southbridge, and to have all-night service. The small stockholders have been notified by the purchaser of the controlling interest, that they can dispose of their stock at $62.50 per share. The par value of the stock is $50.

ONEIDA, N. Y.—The board of public works has entered into a contract with the Empire State Power Company for lighting the streets and public places of the city for a term of five years, the contract bearing date of January 1, 1907. The company is to give a bond of $10,000. Under the new contract the Empire State Power Company will light the city for $3,650 a year, furnishing about ninety lights to burn until 1 o'clock and forty lights to burn all night. Aside from the street lights about seventy-five free incandescent lights are to be furnished for lighting the city offices, police and fire stations, etc.

GOUVERNEUR, N. Y.—Under the terms of the contract made by the village in September, 1904, with the Oswegatchie Light and Power Company to furnish light for the streets of Gouverneur, an all-night service was to be provided after October, 1906. The company now announces that it will be unable to do more than continue the present midnight service, claiming inability at this time to secure the equipment necessary to increase the efficiency of the plant at Hailesboro to the point where all-night service can be given. The request of the Oswegatchie people that the date for furnishing all-night service be extended one year has been granted by the board of village trustees.

DILLSBORO, N. C.—H. S. Harkins has sold to G. W. Reagan and associates a valuable water power on the Tuckaseegee river, near Dillsboro. The purchasers of the water power are Gastonia cotton mill men and it is said to be their intention to develop the water power for the manufacture and distribution of electricity, and also to establish a large cotton mill to be operated by electricity. The water power that has been transferred by Mr. Harkins to Mr. Reagan and others is said to be one of the finest in this section of the state and easily developed. The site of the proposed power plant is scarcely fifteen miles from Bryson City and, if the development plans are carried out, Bryson City will be enabled to obtain electricity for light and power purposes.

TRENTON, N. J.—There has been incorporated at the State House the Portland (Pa.) Power Company with a capital of $500,000. the object of which is believed to be to tap the Delaware river a short distance above Belvidere and divert the water for electrical purposes, carrying it through a canal about four miles to Foul Rift, at which point a power-house will be erected for trolley and electric light and power purposes. The charter of the new company gives the following facts: Registered office, Belvidere; agent in charge, William H. Morrow; capital stock, $500,000; incorporators, Henry D. McDonald, Lewis H. Nickolos, Jennie Killian, Jacob V. Carter and Dayton Brugler. The charter gives the corporation the right to erect dams, build power-houses, generate electricity for light and power, deal in electric power and ice.

INDUSTRIAL ITEMS.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a catalogue and price list of specialties covering every conceivable item necessary for general wiring.

THE NORTHERN ELECTRIC AND MACHINE COMPANY, 22 Brooklyn avenue, Brooklyn, N. Y., has opened an office in Buffalo, N. Y., with William R. Gibson in charge.

THE REED ELECTRICAL CORDAGE COMPANY, Syracuse, N. Y., advises that it is about to increase its manufacturing facilities and to greatly enlarge its quantity of production of insulated wires.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., has produced a very attractive September bulletin describing and illustrating "P.-K." rosettes, baby knife switches, taplets and waterproof socket plugs.

KENDRICK & DAVIS, Lebanon, N. H., manufacturers of high-grade battery motors and electrical novelties, have completed and moved into a large addition to their factory, nearly doubling their capacity.

THE MARSHALL ELECTRIC MANUFACTURING COMPANY, Boston, Mass., reports a very brisk demand for its new rotary flush switch, which is carried in stock in Boston, New York and Chicago for immediate delivery.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., is distributing a new hanger bearing calendars for October, November and December, and the 300 words which have been recommended by the simplified spelling board.

THE MOORE ELECTRICAL COMPANY, 52 Lawrence street, Newark, N. J., has ready for distribution a new pamphlet describing several features of the Moore electric tube light. This pamphlet will be sent to any one interested upon request.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., is distributing a very attractive folder entitled "Have You Struck the Keynote?" This folder calls attention to a special line of porcelain sign receptacles which this company is producing.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, is distributing some new literature describing the "J-M" electric car heaters. The company will be pleased to send full information concerning various classes of car heaters upon application.

THE AJAX LINE MATERIAL COMPANY, 12 and 14 South Jefferson street, Chicago, Ill., will be pleased to send its October bulletin, showing some new outdoor lighting specialties, including pole tops, rainproof rope, galvanized chain, insulators, swivel pulleys, break arms, cleats and mast arms.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has prepared a neat pamphlet illustrating and making brief references to its complete line of products. This is intended merely as a ready reference to the company's material, and suggests in each case where additional information may be secured concerning the product described.

KEOUGH BROTHERS & COMPANY, Boston, Mass., announce that on September 14 the firm was dissolved by mutual consent. All outstanding accounts and contracts have been assumed by Augustus Keough and James E. Keough, who will carry on the business of electrical contractors at 41 North street, Boston, under the firm name of Keough Electric Company.

THE LOWELL INSULATED WIRE COMPANY, Lowell, Mass., is about ready to enlarge its present facilities and is searching for a site upon which to build a much larger works. The plant is under the management of R. Dunsford, and he estimates that a plant with a floor area of from 40,000 to 50,000 square feet will be necessary to meet the demands for the company's product.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is sending to the trade a catalogue descriptive of condulets, and calling attention to the fact that it is carrying a complete stock of all styles and sizes up to and including one inch. These condulets have been on the market for a comparatively short time, but have already made a place for themselves and are becoming popular among contractors and wiremen.

THE STANDARD ELECTRIC LAMP COMPANY, of Newark, N. J., is now established at Van Buren and Ferry streets. The company has recently been reorganized, F. B. Flinn being elected president. The other officers have not been fully chosen, but the names will be announced later. The company has a capacity for refilling 5,000 lamps weekly at the present time. It is announced that this capacity will be enlarged, and that in the near future the company will enter into the manufacture of standard types of lamps.

THE LOMBARD-REPLOGLE ENGINEERING COMPANY, Akron, Ohio, has ready for distribution a new bulletin describing and illustrating Lombard-Replogle water-wheel governors. Nathaniel Lombard and Mark A. Replogle have joined forces, and in addition to their experience, the services of other practical engineers have been secured. The company is getting ready to occupy its new quarters in a commodious building in the centre of Akron, where it will have seven stories with over 100,000 square feet of floor space.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., announces the contract for a new twenty-two-inch by forty-two-inch Reynolds Reliance Corliss engine for direct-connection with a 300-kilowatt, direct-current generator for the Eastman Kodak Company, Rochester, N. Y. A contract has also been made with the Mauch Chunk Heat, Power and Electric Light Company, Mauch Chunk, Pa., for a twenty-inch by thirty-six-inch Reynolds Reliance Corliss engine of the belted type. This engine is to be installed for driving an electrical generating apparatus.

Record of Electrical Patents.

Week of September 25.

831,530. TROLLEY-POLE CONTROLLER. James F. Boggs, Needles, Cal. Filed September 21, 1905. A pneumatic trolley-catcher.

831,548. JOINT FOR ELECTRIC CONDUCTORS AND OTHER WIRES. Austin Fleeger, Chicora, Pa. Filed August 18, 1905. A sleeve with tapering ends containing angular gripping bodies.

831,599. INDUCTIVE SYSTEM. Ralph C. Browne, Salem, Mass. Filed August 19, 1904. A therapeutic device making use of an intermittently charged and discharged condenser.

831,609. ELECTRICAL MEASURING INSTRUMENT. Carl Hering, Philadelphia, Pa. Filed August 3, 1905. The current through two coils in unstable equilibrium reacts so as to limit its variations.

831,624. ELECTRIC RAILROAD. Jeremiah Murphy, Chicago, Ill. Filed February 9, 1906. An inverted grooved third rail and supports.

831,625. VENTILATED ARMATURE. James F. McElroy, Albany, N. Y., assignor to Consolidated Car Heating Company, Albany, N. Y. Filed April 18, 1905. Ventilating ducts are secured by means of punched spacing discs.

831,628. SHADE-HOLDER COUPLING. Edwin F. Pierce, Milwaukee, Wis. Filed October 18, 1905. Renewed June 11, 1906. A holder for incandescent lamp shades.

831,634. ALARM-SYSTEM APPARATUS. Richard F. Spamer, Chicago, Ill., assignor to Consolidated Fire Alarm Company, New York, N. Y. Filed September 23, 1905. An electro-magnetic device for setting off a distant alarm.

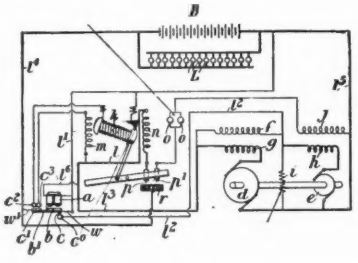
831,685. VARIABLE-SPEED DEVICE. Grant B. Rossman, New York, N. Y. Filed September 29, 1903. A frictional device, the parts being held together magnetically.

831,687. SELECTING AND SIGNALING SYSTEM. Robert J. Sheehy, New York, N. Y. Filed October 9, 1902. An electromagnetic step-by-step mechanism enabling any one of a number of local circuits to be connected into the main circuit.

831,724. METHOD OF FIXING INCANDESCENT LAMPS. Josef Levin, Munich, Germany. Filed November 16, 1905. A method of attaching a socket to the conduit.

831,740. ARMATURE-WINDING MACHINE. Paul E. Oswald, Los Angeles, Cal. Filed October 23, 1905. The armature is rotated about an axis perpendicularly to the shaft, enabling the wire to be laid easily in the slots.

831,776. RAIL BOND. Fred H. Daniels, Worcester, Mass. Filed June 8, 1903. A flat stranded conductor is looped through slots in the bond head.



831,059. AUTOMATIC ELECTRIC SWITCH.

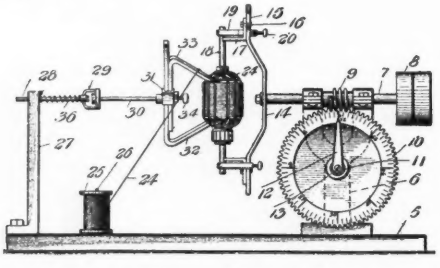
831,779. MAGNETIC SOUND RECORD. Victor H. Emerson, Newark, N. J., assignor to American Graphophone Company, Washington, D. C. Filed January 14, 1904. Renewed March 2, 1906. The crumbling of a magnetic needle leaves a magnetic record on a non-magnetic surface.

831,792. TROLLEY WHEEL. William Livingstone, New York, N. Y., assignor of three-eighths to himself and five-eighths to Empire State Engineering Company, New York, N. Y. Filed March 27, 1905. A wheel formed of sheet metal with a seamless rim.

831,815. CONNECTOR FOR ELECTRICAL CONDUCTORS. Paul F. Williams, Chicago, Ill. Filed May 23, 1905. A pair of insulating members protecting the electrical coupling.

831,819. TELEPHONE SYSTEM. Francis G. Bell, London, England, assignor of one-half to Isidore Bernard Birnbaum, London, England. Filed October 9, 1905. A modified form of common battery system.

831,821. ILLUMINATING DEVICE. Alfred W. Beuttell, London, England. Filed October 17, 1902. A reflector for double-ended incandescent lamps.



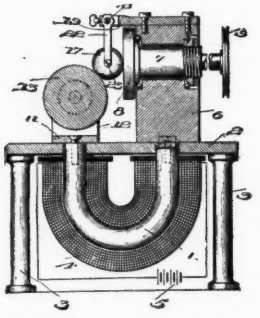
831,740. ARMATURE-WINDING MACHINE.

831,830. RAIL BOND. John P. Clark, Ypsilanti, Mich. Filed May 27, 1905. The terminal is wrapped with wire cloth.

831,843. PROCESS FOR THE ELECTROLYTIC PRODUCTION OF ZINC. Victor Engelhardt, Vienna, Austria-Hungry, assignor to Siemens & Halske Aktiengesellschaft, Berlin, Germany. Filed September 14, 1904. The current density in a sulphate solution is from twenty to fifty times as great at the anode as at the cathode.

831,846. AUTOMATIC TELEPHONE SYSTEM. John Erickson, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed December 30, 1904. Makes use of a selector switch controlled by a differential relay.

831,847. ELECTROTHERMAL SWITCH. John Erickson, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed December 31, 1904. Contact is made or broken by the expansion or contraction of a hard rubber rod.



831,685. VARIABLE-SPEED DEVICE.

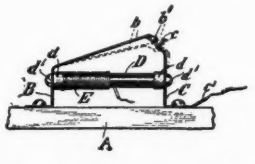
831,848. ADJUSTABLE HARMONIC RINGER FOR SELECTIVE SIGNALING SYSTEMS. John Erickson, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed September 18, 1905. Means are provided for adjusting the fulcrum of the clapper.

831,855. TELEPHONE TRANSMITTER ARM. Harry J. Guttman, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed November 25, 1905. A method of construction.

831,875. INTERRUPTER FOR AUTOMATIC TELEPHONE OR OTHER SWITCHES. Alexander E. Keith, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed February 17, 1905. A device for automatically selecting an idle trunk.

831,876. SWITCHING OR TELEPHONE SYSTEM. Alexander E. Keith, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. Filed March 9, 1905. A method of arranging the plurality of trunk lines and groups of terminals.

831,889. TELEPHONE ATTACHMENT. William A. Patterson, Pittsburg, Pa. Filed October 20, 1905. The transmitter mouthpiece is closed with a perforated cover on which is a shutter.



831,847. ELECTROTHERMAL SWITCH.

831,916. ELECTROSTATIC APPARATUS. Millard Woodsome, Boston, Mass., assignor by mesne assignments, to Huff Electrostatic Separator Company. Filed August 2, 1904. Electrostatic ore separator.

831,959. AUTOMATIC ELECTRIC SWITCH, PARTICULARLY FOR USE IN CHARGING ELECTRIC ACCUMULATORS. Henry Leitner, Woking; Richard N. Lucas, Byfleet, and Harry Hill, Woking, England; said Hill assignor to said Leitner and Lucas. Filed February 10, 1905. The switch is controlled by a compound-wound magnet.

831,996. LAMP SUPPORT. Adolph Rydquist, Rochester, N. Y. Filed September 14, 1905. A three-armed frame holding an adjustable support.

832,024. PROCESS FOR THE ELECTRODEPOSITION OF METALS. Josef A. Nussbaum, Charlottenburg, Germany, assignor to Siemens & Halske Aktiengesellschaft, Berlin, Germany. Filed November 28, 1905. A colloidal diaphragm is formed over the surface to be coated.